E.M. Baker

The Monthly Review

AMERICAN ELECTROPLATER'S SOCIETY

A SOCIETY FOR THE ADVANCEMENT OF THE SCIENCE OF ELECTROPLATING

NOVEMBER — 1942

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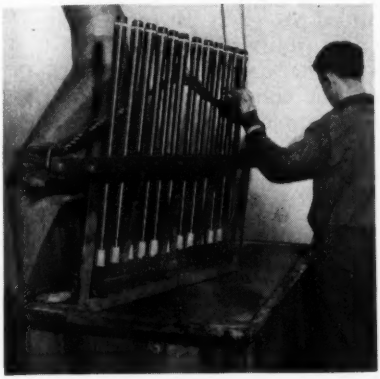

THE COVER

Picture illustrates process of stripping hard chrome from aeroplane machine gun barrels prior to replating.

Courtesy of Pennsylvania Salt Manufacturing Company.

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Editorial

Now that the recorded minutes of the annual business meeting have been printed and distributed to each Branch secretary, the door is open for a sincere and deliberate discussion of the course the Society shall take in the coming years. Another milestone has now been reached in the history of the A.E.S. That the advent of war has brought us to the mark more quickly than could the normal course of events, is unimportant. It only matters that we have arrived.

With increasing acuteness, as platers, we have observed and realized, in recent years, the amazing expansion of our field of endeavor. To enumerate these additional duties would be superfluous and serve no purpose here. It is significant only that we have known the day was not far distant when we would be required to decide whether to continue as a Society interested in electroplating, or as a Society interested in industrial finishing. It would appear that we have not all fully, rationally, and deliberately prepared ourselves for the issue when it came due last June. Surely, therefore, there must be much in our minds which has been unsaid or unwritten on the subject.

While most of the Branches were represented at the annual business meeting by delegates, few will sense the feeling that was prevalent during the discussion of this problem, by a consideration of their delegates reports. There is, however, a way of recapturing that atmosphere. To repeat — the door is open. Suppose each Branch makes it a point of duty to have their secretary read the pertinent parts of the annual minutes. Once the secretary has read and focussed attention on the complete recording of the discussion, let the members review each expression of opinion, discuss it pro and con, and record their majority reaction. So let them proceed, through the entire discussion, taking several meetings to do so, and finally summarize their general attitude.

If someone feels he wants to write about it, by all means let him do so. Then let the matter rest a month and recheck opinions — a procedure psychologically similar to writing that letter to the boss in a heated moment and then calmly destroying it after we read it the next morning. At least one branch reported a change in attitude upon reconsidering the first amendment proposed. Discussion need not be influenced by the possible form the next proposal will take, the issue will always be fundamental.

Now is the time to start; now, when there is no need for hurry; now, while we can speak with out heads and not our hearts because, figuratively, we can count to ten before we speak. Then, there are those of us who think best on our feet while others of us do better with the pen, some of us wax eloquent in meetings while still others lose our voices. Now we have the time to give everyone an opportunity to express his opinion in the manner which is easiest and best suited for him, and thereby obtain a true picture of what is really desired.

We are not here concerned with opinion on the problem, pro or con, but rather with pointing out that June, 1943 is nearer than we realize, that your committee appointed to study the problem must have time to correlate opinions, and that above all, we must debate the issue with opinions which have been determined rationally, deliberately, and unhurriedly.

C. C. HELMLE.

MASTERS' ELECTRO-PLATING ASSOCIATION HOLD MEETING OCT. 14, IN NEW YORK CITY

Rate of Operations

Rate of operations among members for week ending October 3rd was 62% as compared with 60% in September and 82½% September 1941. Despite extensive correspondence between Association and small plants division of W.P.B. and New York City Department of Commerce, little concrete results have resulted. Nevertheless war work is showing a slow volume increase in local plants.

W.P.B. Orders

Zinc ruling previously reported has been revised by Zinc Branch of W.P.B. Strict attention should be given by all platers to the rulings that now apply.

Silver Conservation Order M-199

Electroplating with foreign silver is stopped by above order on all work carrying a rating lower than A-3. Order of Oct. 1 has been extended to Nov. 15th. Also ruled that for repair work it is permissible to use up to 5 oz. of foreign silver per article.

Nickel Conservation Order M-6-B

A new amendment was issued to Nickel Conservation Order M-6-B dated October 3 which prohibited the use of nickel on any product, whether or not on List A, unless the nickel had been allocated for such purposes by the Director General for Operations, or with his specific permission, or for use in implements of war (combat end products) for the Army, Navy, Maritime Commission, War Shipping Administration or Lend Lease manufacturers.

Free Treasury Silver for Industry

A campaign undertaken by the Silver Users Emergency Committee mentioned in our September Bulletin is moving ahead, to make silver available for industry from the stocks of "free" silver in the hands of the U. S. Treasury. A bill has been presented in the Senate by Senator Green of Rhode Island, Senate bill S2768, which has the approval of the Silver manufacturing industries of the U. S. as represented by the Silver Users Emergency Committee. Electroplaters are urged to write to their Senators and Congressmen to get behind this bill.

SPEAKERS AVAILABLE FOR VARIOUS BRANCHES FOR THE YEAR 1942-1943

Alsop Engineering Corporation—Milldale, Conn.—R. J. Green.

Abbott Ball Co.—Hartford, Conn.—J. H. Donahue.

Champion Fibre & Paper Co.,—Hamilton, Ohio—W. B. Stoddard, Jr. (Within 50 miles of Hamilton only; Expenses to be borne by Branch)

E. I. duPont deNemours Co.—Wilmington, Delaware—F. F. Oplinger.

Darco Corporation—60 E. 42nd. St., New York, N. Y.—W. A. Helbig. West to Chicago; South to Baltimore-Washington only)

Divine Brothers—Utica, New York—B. D. Divine. (In the East only)

Egyptian Lacquer Mfg. Co.—Rockerfeller Center, N. Y.—C. A. Lankau.

General Electric Co.—1 River Rd., Schenectady, N. Y.—C. M. Ripley.

Houdaille-Hershey Corp.—2660 E. Grand Blvd., Detroit, Michigan—Walter L. Pinner. (Expenses to be borne by Branch)

Guide Lamp Division, G. E.—Anderson, Indiana—R. M. Wagner. Dr. D. A. Cotton. (Expenses to be borne by Branch)

G. B. Hogaboom Jr., & Co.,—44 E. Kinney St., Newark, N. J.—N. Hall.

Hanson-Van Winkle-Munning Co.—Myron B. Diggin and Allen T. Baldwin Matawan office for the East.

Hanson-Van Winkle-Munning Co.—M. J. Moll, Matawan Office.

Hanson-Van Winkle-Munning Co.—Vincent Mattacotti, 2920 Carroll Ave., Chicago, Ill. for the Chicago area.

Hanson-Van Winkle-Munning Co.—B. C. Case, 2842 West Grand Blvd., Detroit, Mich. for the Detroit area.

Indiana University—Bloomington, Indiana—Frank C. Mathers. (Expenses to be borne by Branch)

LaSalco, Inc.,—2822 LaSalle St., St. Louis, Mo.—B. G. Daw. (In the West anytime; in the East in March or April only)

Oakite Products Co.—22 Thames St., New York, N. Y.—John A. Carter.

United Chromium—51 East 42nd. St., New York—T. G. Coyle, H. D. McLeese, Dr. J. E. Stareck. (Any Branch East of Chicago)

Udylite Corporation—Detroit, Michigan—Gustaf Soderberg. (Any Branch except those in California)

Westinghouse Elec. & Mfg. Co. 10 High St., Boston, Mass.

Westinghouse Elec. & Mfg. Co. 40 Wall St., New York

Westinghouse Elec. & Mfg. Co. 3001 Walnut St., Phila., Pa.

Westinghouse Elec. & Mfg. Co., 411 No. 7th St., St. Louis, Mo.

Westinghouse Elec. & Mfg. Co. 20 N. Wacker Drive, Chicago, Ill.

Westinghouse Elec. & Mfg. Co., 2519 Wilkens Ave., Baltimore, Md.

Westinghouse Elec. & Mfg. Co. 1216 West 56th St., Cleveland, Ohio

Westinghouse Elec. & Mfg. Co. 210 East 6th St., Charlotte, N. C.

Westinghouse Elec. & Mfg. Co. 1 Montgomery St., San Francisco, Cal.

Westinghouse Elec. & Mfg. Co. Trafford City, Penna.

Colonial Alloys Co.—E. Somerset, Trenton Ave. & Martha Sts., Phila., Pa., Dr. Engel and Mr. Cohn.

GEORGE WAGNER, 1*st Vice-Pres.*

Reclaiming Nickel From Idle Plating Baths

ABSTRACT

The results of laboratory tests on three possible wet methods for recovering nickel are presented. These are (1) the cementation of nickel on finely divided iron to yield an iron-nickel powder mixture, (2) electrolysis with insoluble anodes, and (3) electrolysis with steel anodes to produce an iron-nickel alloy deposit. Data obtained were favorable to the last process in respect to cost and ease of operation in equipment available in the average plating plant. The results are given in sufficient detail to enable an operator to plan efficient and economical recovery of his nickel.

Early this year it became evident that government agencies should take steps to conserve and recover for war production use the large amount of nickel present in the idle nickel plating baths of the country. High transportation costs and the lack of idle refinery facilities precluded simple shipping of solutions in bulk to central points for conversion of the nickel salts to some usable form. At the time the work was undertaken, it did not seem feasible to arrange for evaporation of the solutions at plating plants and subsequent conversion of the dry salts to metallic nickel at refineries, but later information on improved handling methods have made this procedure a continuing possibility. The Research Laboratory of the International Nickel Co., Inc. was asked to investigate briefly methods for recovering nickel which could be applied in the average plating plant. Sufficient basic information was wanted to permit selection of the best procedure in point of speed and economy in returning nickel into useful channels.

By W. A. WESLEY and E. J. ROEHL,

Assistant Director and Research Chemist Research Laboratory, The International Nickel Co., Inc., Bayonne, N. J.

Consideration of the problem with R. L. Suhl, R. J. McKay and with N. B. Pilling of this Company led to the decision to investigate the following processes:

(1) Precipitation of nickel by addition of iron powder. A method for coating steel with nickel by cementation had been developed at Bayonne so that it was known that such a reaction is possible. In using iron powder the anticipated product was a powder containing metallic nickel and iron which could be dried, melted and cast to a suitable form for addition in the manufacture of steel.

(2) Electrolysis using insoluble anodes, with periodic addition of an alkali to neutralize the acid set free and maintain a high current efficiency. The merits of ammonia and the less expensive base $Ca(OH)_2$ were to be compared. The product would be a pure nickel deposit.

(3) Electrolysis using soluble iron or steel anodes to produce a nickel-iron alloy deposit which could be used directly in steel manufacture.

Bath Composition:

All the experiments were started with baths of the following composition which was considered representative of a large proportion of the idle nickel solutions except that it contained no brighteners or wetting agents:

Nickel sulfate	40 oz. per gal. (300 g.p.l.)
Nickel chloride	6 oz. per gal. (45 g.p.l.)
Total Ni content	10 oz. per gal. (75 g.p.l.)
Boric acid	4 oz. per gal. (30 g.p.l.)

The pH values were determined with a glass electrode at regular intervals, sulfuric acid additions or the indicated alkali additions then being made to restore the desired pH.

It was necessary to use a modified procedure in making nickel analyses due to the presence of relatively large amounts of iron during most of the tests to be described. A 2 ml. sample was filtered in a small Buechner funnel and washed with a small quantity of distilled water. To the filtrate was added 100 ml. of a pyrophosphate solution containing 50 g.p.l. sodium pyrophosphate, 50 g.p.l. ammonium chloride and 2 g.p.l. potassium iodide. The solutions were mixed and transferred to a 250 ml. Erlenmeyer flask. The filter flask was rinsed with an additional 50 ml. of the pyrophosphate solution which was then added to the Erlenmeyer flask. The solution should be clear at this point. It was then titrated with standard sodium cyanide reagent until the first precipitate formed just redissolved. Solutions containing large amounts of iron cloud up again on standing after the end point is reached. The first end point is the correct one and the titration should be performed rapidly.

Precipitation of Nickel with Iron Powder:

In each of the four experiments which follow, iron powder (80 to 100 mesh) was added to 2 liters of nickel plating solution in an initial amount equivalent to the total quantity of nickel present. The pH was maintained between 4.5 and 5.0 and the temperature held at 160°F.

(a) **Stagnant Solution.** At the end of 10 days 60 percent of the nickel had been displaced from solution and action had ceased. Another dose of iron powder was added with the result that about 76 percent of the nickel was precipitated in a total of 13 days. The sludge was washed twice by decantation, filtered, dried and analyzed. The amount of nickel recovered agreed closely with that estimated above. The product contained some ferric hydroxide and showed upon analysis 45.9 percent nickel and 21.5 percent iron. It was contaminated with sulfates (a metallurgically undesirable constituent) to the extent of 9.2 per cent SO_4.

(b) **Mechanically Stirred Solution.** In this experiment vigorous agitation was provided by means of a stirrer. Reaction was faster at the start and 63 percent of the nickel was removed from solution before action had stopped at the end of 75 hours. A second charge of powder was added. After about 25 hours nickel began to redissolve so the sludge was removed and it was found that a total of 80 percent of the nickel was recovered. This sludge contained 53.4% nickel, 16.8% iron and 9.4% SO_4.

(c) **Continuous Air Agitation.** Air agitation proved to be more effective than mechanical stirring since 80 percent of the nickel was removed from solution in 70 hours. At this point addition of more iron powder did not cause precipitation of more nickel so the sludge was removed by filtering. The product showed upon analysis: 59.0% nickel, 22.3% iron and only 1.4% SO_4. The iron appeared to be largely present as ferric hydroxide. More powder was added to the filtered solution and an additional 8 per cent. of the nickel was recovered in 85 hours. The consumption of iron powder in precipitating the first 80 percent of the nickel was 1.3 lbs. per lb. of nickel recovered.

The advantage of air agitation in speed of removal of nickel is probably due to continuous elimination of dissolved iron by oxidation and precipitation as ferric hydroxide, since accumulated ferrous ions slow down the rate of nickel cementation:

$$Fe + Ni^{++} = Fe^{++} + Ni$$

This advantage is accompanied by a disadvantage, namely, that the nickel sludge produced contains ferric hydroxide instead of metallic iron powder.

(d) **Use of Cast Iron Chips:** Since powdered iron is rather expensive, one run was made with substitution of clean cast iron

chips from a machining operation. The chips reacted entirely too slowly with only 8.5 percent of nickel recovery in a week.

Electrolysis with Insoluble Anodes:

Two experiments were run using two carbon anodes, each 1 in. by $\frac{1}{4}$ in. by $5\frac{1}{2}$ in., immersed to a depth of 4 in., and a single steel cathode 2 in. wide by 6 in. long with a cathode area of 0.17 sq. ft. The solution volume was 0.53 gallon (2.0 liters) and since the total current was held at 3.4 amperes, this corresponded to 6.4 amp. per gallon of solution and 20 amp. per sq. ft. of cathode. The solution temperature was held at 120°F.

Strong evolution of chlorine was noted during the first 11 hours of electrolysis but not thereafter. This is a decided drawback to this method of recovering nickel since it would be difficult to vent the chlorine adequately in the average plating plant.

In the first experiment a suspension of finely divided $Ca(OH)_2$ was added periodically, usually every hour, to prevent the pH of the solution from dropping below 1.5. This method of neutralization was quite unsatisfactory because the particles of lime reacted very slowly, settled to the bottom and there continued to react until nickel hydroxide was actually being precipitated in the lime sludge while the bulk of the solution was at a low pH.

In the second experiment ammonia was used to maintain the solution pH between 2.0 and 5.0. After electrolysis to the extent of 300 amp. hours per gal. or an elapsed time of 86 hours, 92 percent of the nickel had been recovered in the form of a good compact deposit with an average cathode efficiency of 67 percent. During this time the consumption of ammonia was equivalent to 1.08 lbs. NH_3 per lb. of nickel recovered. The average tank voltage was 3.75 volts so that the power consumption was 2.6 kw. hrs. per lb. of nickel. This would be considerably increased in some commercial plants where an anode to cathode spacing greater than 2 inches might be necessary.

Electrolysis with Soluble Steel Anodes:

Electrolysis of a nickel plating solution with steel anodes should yield a pure nickel deposit at the cathode at the start. As more and more iron dissolves in the electrolyte a nickel-iron alloy is produced which becomes gradually richer in iron. It was considered that the product should be suitable for direct addition to steel melts so long as it was obtained in a fairly compact form.

In the first experiment a 2-liter bath was electrolyzed at a temperature of 120°F with two mild steel anodes, 3 in. by 6 in. by $\frac{1}{8}$ in., and a mild steel cathode area of 0.14 sq. ft. The anode cathode spacing was 2.5 inches. The solution pH was maintained between 5.0 and 5.6 by periodic addition of sulfuric acid. With the cathode current density held at 20 amp. per sq. ft. and no agitation it was found by analysis of the bath that 70 percent of the nickel had been removed when a total of 310 amp. hrs. per gallon of solution had been passed through the cell. During the next 100 amp. hrs. little nickel was recovered, as shown in figure 1, curve 1, which meant that iron was being deposited with little nickel in it. The current density was then lowered to 5 amp. per sq. ft. and nickel deposition was resumed. When about 90 percent of the nickel had been recovered the rate of nickel removal was low again and the test was discontinued. The results are presented in various ways in table 1. The entire cathode from the first period of experiment 1 was dissolved and analyzed. After correcting for the weight of the steel starting cathode in it the result showed that the deposit was a nickel-iron alloy with an average nickel content of 49%.

The deposit obtained during the first period of this experiment was light grey in color at first and became darker as the amount of iron in it increased. It was sound, adherent and rough at the end of the first period and sound, adherent and smooth in the second.

Effect of Higher Current Density:

Before completion of our study, the tests of Walter Pinner at the Houdaille-Hershey Corporation as mentioned hereafter were in progress, and certain features of his results indicated the value of further attention to the current density.

In experiment 2 a ten-liter bath was electrolyzed using a wider anode to cathode spacing (4.5 inches) to more closely represent plant conditions. A higher current density was employed and the influence of this and the wider electrode spacing is reflected in the greatly increased power consumption shown in Table I. The progress of the nickel removal can be followed in figure 1. The first 68 percent was deposited rapidly. When the recovery rate had become low the current density was raised. This change increased the amount of nickel in the deposit just as did

lowering the current density in experiment 1. After a time the current density was lowered to 5 amps. per sq. ft. at which level the rate of recovery was also greater than it had been at the end of the original electrolysis period of 35 a.s.f. It can thus be concluded that either raising or lowering the current density is effective in resuming nickel deposition when that bogs down upon continued electrolysis of the bath at 20-35 a.s.f.

The deposit in this experiment showed high stresses with some cracking and peeling during the 35 a.s.f. period but at 45 and at 5 a.s.f. the deposit was sound and adherent, albeit dark in color.

Effect of pH:

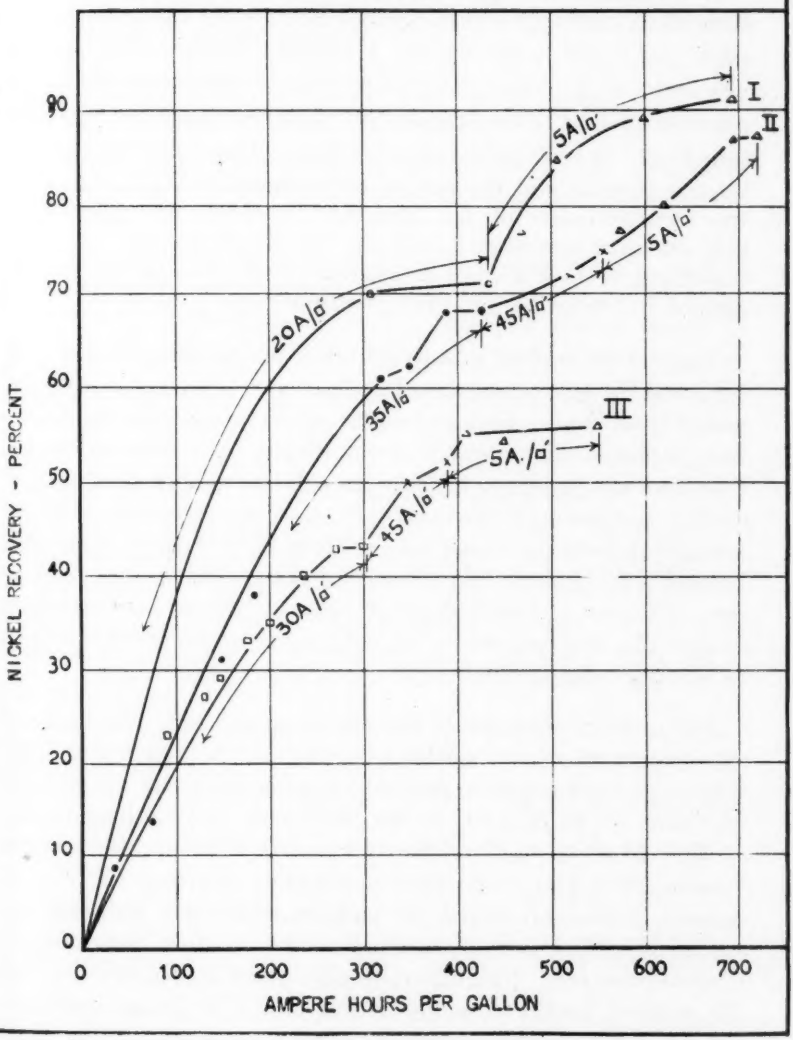
The final experiment was started as a duplicate of experiment 2 except that the pH was maintained at 2.0-3.0. The results are included in figure 1 and table I and show that nickel recovery is less efficient and more costly at low pH than it is at a high pH.

Comparison of Methods:

The results of the tests on precipitation with iron powder, electrolysis with insoluble anodes and experiment 1 of electrolysis with steel anodes were discussed at a conference with W. L. Pinner of the Houdaille-Hershey Corp. and R. J. McKay of this company. The object was to evaluate the several proposed methods as to expense and general suitability for the plater who would be asked to apply it in his own plant with only such equipment as he had available. The cementation on powdered iron seemed objectionable not only because this reagent is expensive but also because the average plating establishment is not equipped to handle, dry and package large amounts of a sludge and there is apt to be serious contamination of the product with sulfates. It would also probably be necessary to briquet or melt the powdered product before it could be used in steel making.

Electrolysis with insoluble anodes seemed unsuitable and was rejected because the power consumption was so much higher than that in the experiment with soluble anodes at the same electrode spacing, the consumption of a pound of NH_3 per lb. of nickel recovered represented a heavy cost, and the evolution of chlorine in the early stages of electrolysis would create a serious ventilation and corrosion problem in most plants. However,

FIGURE 1.
CONTROL CHART • ELECTROLYSIS WITH STEEL ANODES.



it was realized that this method might be attractive to some operators, particularly since the deposit is pure nickel and a recovery of over 90 percent can readily be made.

It was concluded that the electrolysis with steel anodes was sufficiently attractive that arrangements were made to have a pilot plant run made by the Houdaille-Hershey Corporation. The only major disadvantage is that variation of the nickel content of the electrodeposited product precludes accurate sampling. A 1900-gallon nickel plating solution has been treated by this process and the test was described by W. L. Pinner in the October issue of the Monthly Review. In addition to this practical test some laboratory work was carried out by G. Soderberg of the Udylite Corporation.All of these data were considered in preparing the present discussion.

There were several points of difference between Pinner's results and the laboratory data but these were differences of degree rather than kind. Iron and nickel are so nearly alike in deposition potential that opposite results have been reported in the literature for the effects of such variables as temperature, current density and pH upon the ratio of Fe:Ni in deposits from solutions containing both these elements. These factors can be controlled in most plating plants but other conditions which appear to affect the Fe:Ni ratio cannot be reproduced everywhere, such as, degree of agitation and convection, stratification, ratio of electrode areas to solution volume, etc.

The product obtained in the plant test was richer in nickel, if the overall average is computed, than in the laboratory tests. When the yield began to drop off, a lowering of the current density from 30 to 20 a.s.f. in the plant test did not improve the results, whereas in the laboratory tests lowering the current density to 5 a.s.f. was always effective. Raising the current density to 45 a.s.f. raised the yield in both cases although this led to excessive power costs when the solution became poor in nickel content. The optimum pH cannot be ascertained from the data at hand. A value as low as 2.0 is undesirable, particularly in the later stages of removal of nickel. The plant yields were good in the neighborhood of 4.0 and good results were obtained in the laboratory at 5.0 to 5.6.

Summary of Method for Recovering Nickel from Watts-Type Baths:

Anodes: Steel or iron. Form not critical.

Cathodes: Steel sheets.

Anode to Cathode Spacing: As small as possible without danger of short-circuiting.

Bath temperature: 120°-140°F.

pH: Can be low at start, then allow to rise to 4.0-5.0.

Analysis of Bath: Should be made daily. Plot a curve of amp. hrs. versus amount of nickel removed from solution. (Fig. 1).

Current density: Start at 30-40 a.s.f. Observe curve plotted as above. When curve flattens, this means too much Fe, too little Ni in the deposit. Raise the current to 40-45 a.s.f. if power available. Otherwise lower to 5 a.s.f.

Deposit: Examine periodically. Knock off and collect trees and loose nickel.

Table I—Electrolysis with Steel Anodes

Experiment	*One*		*Two*			*Three*		
pH	(5.0-5.6)		(5.3-5.6)			(2.0-3.0)		
Current density: amps./sq. ft.	20	5	35	45	5	30	45	5
Nickel conc. in bath in oz./gal. Start:	10.5	3.0	10.2	3.1	2.5	10.2	5.8	4.8
Stop:	3.2	0.94	3.1	2.5	1.3	5.8	4.8	4.5
% Ni. removed during this period:	70	20	68	7	12	43	9	4
Amp. Hrs./gallon	310	265	425	130	140	300	90	160
Amp. Hrs./lb. Ni removed:	700	2050	990	3100	1870	1090	1600	7000
Anode to cathode spacing: inches	2.5	2.5	4.5	4.5	4.5	4.5	4.5	4.5
Tank voltage, average:	1.5	0.8	4.8	5.2	1.08	3.4	5.0	1.0
Kw. Hrs./lb. Ni	1.05	1.64	4.75	16	2	3.7	8.0	7.0
Lbs. steel anodes dissolved per lb. Ni.	1.6	5.4	2.3		4.9	2.6	3.8	17
Average Ni content estimated from change in Ni content of bath:	52%	22.5%	43%	17.3%	24%	40%	27%	6.5%

The Fundamentals of Electrochemistry and Electrodeposition

XIII. Electrode Potentials and the Displacement of Metals.

By SAMUEL GLASSTONE
D. Sc., Ph. D.
Professor of Chemistry
The University of Oklahoma
Norman, Oklahoma

FROM the arguments presented in the two preceding articles (Part XI, September 1942; Part XII, October, 1942) it will be evident that the metals with the higher negative standard potentials should have a greater tendency to pass into solution as ions than those metals having smaller negative, or positive, potentials. In other words, the higher the position occupied by the metal in the table of standard potentials, given in Part XII, the greater will be its tendency to yield ions in solution. The difference in behavior of different metals in this respect is well illustrated by the familiar replacement of one metal from solution by means of another. For example, if a piece of clean zinc is immersed in a solution of copper sulphate it will be observed that the zinc becomes covered with a layer of metallic copper. What has happened may be accounted for in the following manner. Because the zinc has a greater tendency to form ions in solution than does copper, the atoms of metallic zinc (Zn) drive the copper ions (Cu^{++}) out of solution to form metallic copper atoms (Cu), while the electric charges are transferred to the zinc atoms which go into solution as zinc ions (Zn^{++}). The interaction which occurs may be represented in its simplest form by the equation

$$\underset{\text{atoms}}{Zn} + \underset{\text{ions}}{Cu^{++}} = \underset{\text{ions}}{Zn^{++}} + \underset{\text{atoms}}{Cu} \quad .$$

The Displacement Series

We have here an illustration of the phenomenon known as the "displacement of metals". Metals with a marked tendency to form ions, that is metals which have high negative potentials, will displace those with a smaller tendency to produce ions, that is those having lesser negative, or positive, potentials. It can be seen, therefore, that the table of standard potentials may be regarded as a "displacement series", sometimes called the "electromotive series"; metals higher in the series will, in general, displace from solution those below them. The further apart they are in the table, i.e., the greater the difference in the potentials, the more completely will the upper one, with the more negative potential, displace the lower one, with the less negative, or positive, potential. Thus, the noble metals copper, silver, mercury and gold are easily driven out of solution by such base metals as aluminum (clean), zinc, iron and cadmium. There are certain limitations to the general rule which will be considered shortly.

Liberation of Hydrogen

Since hydrogen occupies a definite position in the electromotive series, it should behave like metals in respect of displacement from solution. Metals above hydrogen in the table should thus be able to liberate this gas from solution. Potassium, sodium and, to some extent, magnesium attack water, and most of the other base metals dissolve readily in mineral acids to evolve hydrogen. Theoretically metallic lead should also set free hydrogen from acids, but the situation here is complicated by a phenomenon known as "overvoltage"; this will be described more fully in a later article.

Silver Strike Deposits

The displacement of one metal by another is of frequent occurrence in various aspects of electrodeposition. For example, it makes necessary the preliminary "strike," in which the material to be plated is coated with a thin layer of metal before being placed in the actual plating bath. If a base metal or alloy, such as brass, nickel silver or Brittania metal, is inserted in an ordinary silver (cyanide) plating bath, the base metal displaces the silver from solution, thus producing what is generally known as an "immersion" deposit. As a general rule this deposit is rough and non-adherent, so that any metal subsequently plated

upon it would tend to peel off easily. Such a deposit would thus be highly unsatisfactory. In order to avoid this difficulty, special solutions, known as "strike solutions", are used for the preliminary coating. These solutions generally contain much less silver and more cyanide than do the regular baths and are not suitable for continuous plating. However, when a base metal is placed in the strike solution the immersion deposit is very slow to form, and hence it is possible, by the use of current, to plate out a smooth, adherent initial deposit. Once the "work" has become coated with a silver strike in this manner, no further immersion deposition will occur; it can then be removed, rinsed if desired, and then transferred to the regular plating bath.

Mercury Dip

The mercury dip, often used as a preliminary treatment for certain metals or alloys containing copper, tin or zinc, depends on the displacement from a solution of a mercuric salt of the noble metal mercury, with a positive potential, by the less noble metal copper, tin or zinc, having a less positive or a negative potential. The layer of mercury produced on the work in this manner, by simple immersion, serves to some extent the same purpose as the strike deposit. Since mercury is a noble metal it cannot displace silver, particularly from a cyanide solution, and hence there will be no tendency for an immersion deposit of silver to be formed when the material to be plated is placed in the ordinary cyanide bath. Nevertheless, it is the practice to provide a strike of silver to aid the adhesion of the deposit.

Copper Strike in Nickel Plating

It will be seen from the table of electrode potentials that zinc has a more negative potential than nickel; hence the former can displace the latter from solution. In the plating of zinc or zinc alloys with nickel there is consequently a danger of the formation of discolored, non-adherent, immersion deposits of metallic nickel as soon as the work is inserted in the plating bath. In order to avoid this danger a special strike bath may be used, or the zinc material may be plated with a thin deposit, or strike, of copper. This metal has a more positive potential, i.e., it is more noble than nickel and there is now no tendency for the production of an immersion deposit of nickel when the work is put into the regular plating bath.

Immersion Plating

Immersion plating, also called "dip" plating, of silver and gold

is sometimes employed deliberately for low-cost articles. Good adherent deposits may be obtained by means of special solutions, but the thickness is no more than a few millionths of an inch. It is not possible to obtain immersion deposits of appreciable thickness, because once the base metal has become covered with silver or gold it behaves as if it consists entirely of the noble metal and further displacement ceases. It may be noted here that in order for immersion deposition to be possible the base metal must be clean and free from a coating of oxide. Aluminum, stainless steel and chromium have, theoretically, negative potentials and so should displace noble metals quite readily. However, the former are generally covered with an adherent, and usually invisible, oxide film; this makes the material effectively more noble. If the film is removed, and prevented from reforming, the expected displacements can occur.

Another application of the displacement of one metal by another is found in the process often used to recover silver and gold from waste solutions. The addition of a base metal, iron or zinc, results in the gold or silver being turned out of solution. The same type of procedure has also been employed in the metallurgy of gold and silver; the metals are precipitated from cyanide solutions by the addition of scrap zinc.

Displacement in Complex Cyanide Solutions

In the foregoing treatment it has been tacitly assumed that the potentials which determine whether one metal will displace another from solution are the standard potentials. This is reasonably true if the solution contains simple ions of the metals at reasonable concentrations. If complex ions can be formed, however, the arguments apparently break down. Thus cadmium will displace copper almost completely from a sulphate solution, but from a complex cyanide solution there is little, if any, displacement. The correct rule for determining if one metal will displace another is that the former should have a more negative potential than the latter *in the particular solution under consideration*. In a sulphate solution the potentials of cadmium and copper are about -0.4 and +0.3 volt, respectively, so that the cadmium can displace the copper. In a cyanide solution, containing excess of free cyanide, the respective potentials are both in the vicinity of -1.0 volt, and hence there is little tendency, if any, for one metal to displace the other.

Ceramic Coating of Electro-deposited Silver

By C. C. Helmle
General Electric Co.

IT will be remembered that during the closing hours of the appliance industry there was little left to such manufacturers but steel and silver. Thus it was that news of the vitreous coated silver finish fell upon ready ears. Not only did it offer a possibility for completing an unbalanced inventory of parts but its own intrinsic properties recommended it for investigation as a new and unique finish for the future — a finish certain to capture the imagination of product designers and consumers.

The finish under discussion, we must admit, is not basically new having been used in miniature, shall we say, in the jewelry trade for many years. It has, however, "grown up" through the commendable efforts of the Harshaw Chemical Co., who have appropriately and descriptively named it "Jewel Finish."

As a final word of introduction one cannot help but recognize in the process the ever and rapidly broadening field of activity of the electroplater. He has, during recent years, frequently become quite expert with organic finishes and now we see his entrance into the field of ceramics.

The process in outline, consists of plating silver on steel and directly applying a coating of clear glass with or without a color tinting, followed by the usual firing or fusing operation. Our first reaction to this description, thinking in terms of vitreous enameling experience, was quite normal, which is to say we felt the thermal and mechanical shock resistance would be inadequate even though it was obvious that tarnishing and scratching would be eliminated. Opinions were soon reversed by the crude but certain test of dropping a finished toaster housing from table level onto a linoleum covered wood floor. Only after several repeated droppings did the coating actually leave the base metal, and then only at the point of impact. The first few impacts caused only minor cracking of the coating.

Testing for thermal shock consisted of operating a completed toaster continuously for four hours and allowing ice water to drip on the hottest area about every half hour. At the end of the test the area was covered with a web of small cracks but very little enamel had shattered off. One fact however must be stressed at this point, that is, such results are attainable only when the processing is carried out very carefully in accordance with instructions.

The preparation of the base metal is dependent upon the final quality desired. Unpolished steel may be plated directly provided there are no die marks or that they are not objectionable. Since the coating is clear such imperfections show very distinctly. The most satisfactory method found was to polish out die marks, etc. with a 180 greased emery wheel followed by a 220 grain wheel. After polishing, the work was put on a cloth wheel with a fine abrasive, being careful to blend out stop-off marks. As in other types of finishing a buffed surface gives the best results but, generally speaking, the above described finish will be found quite adequate. Uniformity of appearance is absolutely necessary for high quality finishing.

The method of cleaning found to be most satisfactory consisted of the following sequence:

Anodic Alkali Clean	1-2 minutes
Cold Water Rinse	
Muriatic Acid Pickle 50% by vol.	
Cold Water Rinse	
Cyanide Dip 2 oz./gal. NaOH 4 oz./gal. NaCN	30 seconds

After the cyanide dip the work is transferred directly to the strike solution and subsequently to the Silver plating solution.

Since it is possible to do an entirely satisfactory job with .0001" of Silver plate it is highly important to give careful consideration to racking and location of work in the plating tank. All efforts must be directed toward facilitating the greatest uniformity of deposition because of the transparency of the enamel and the impossibility of doing any work on the silver plate after it is removed from the tank. For example, a better appearing product

is obtained by making contact to large pieces either at top and bottom or at some centrally located point, rather than by simply hooking onto some corner. Work should be arranged in the tank in such a manner as to prevent shading. The distance apart will of course be to a great degree determined by the depth of the parts being plated, neglecting changes in throwing power due to other conditions. As a corollary of the above, and aside from being sound economical practice, the racks must be insulated to prevent shading from this source.

It is necessary to obtain a certain type of fairly large grained deposit in order to satisfy both the requirements of adhesion of enamel and uniqueness of appearance. If the well known dull white or ivory color is obtained, the final finish is very similar to ordinary white enamel and hence there is little advantage in appearance. Conversely, if a plate of maximum brightness is obtained a delightfully unique product results which, unfortunately, has a poorer degree of adherence. Thus a compromise is necessary which takes the form of a semi-bright deposit. This deposit exhibits a myriad of small irridescent spots when viewed under obliquely reflected light. These spots, obviously, are the variously oriented crystal faces. Adhesion of the enamel to this deposit is satisfactory and little of the unique metallic "underlighting" is sacrificed.

Uniformity of deposition is again stressed if, economically, the minimum amount of silver is to be applied. When the silver is too thin the enamel will attack the steel through the silver coating and itself be discolored a deep gray black by reaction with iron.

With the above considerations in mind the solution used is essentially a modification of Wood's Silver solution. The composition of the strike and plating solutions recommended are as follows:

Strike

$AgNO_3$	.5 oz./gal.
NaCN	10-15 oz./gal.
KNO_3	10-16 oz./gal.
Temperature	Room (70°)
CD	50 amps./sq. ft. although satisfactory results were obtained with current at 10 amps./sq. ft.
Time	1-2 minutes.

The prime requisite as always of the strike operation is that the work becomes quickly and uniformly covered with a rather bright uniform silver coating.

	Plate
$AgNO_3$	4 oz./gal.
NACN	4-6 oz./gal.
KNO_3	16 oz./gal.
Temperature	75°-95° F.
CD	at 75° 2-4 amps./sq. ft. at 95° 4-6 amps./sq. ft.

While current densities are given, it is recommended that the operator be guided on current required by the type of deposit which he is obtaining, always adjusting his current for the existing conditions, so as to obtain the particular type of deposit described above. The current required will vary from day to day due to changes in temperature and changes in concentration of free cyanide, metal, and carbonate. The free cyanide content has a very pronounced effect on the color of the plate and so, of course, on the final finish. The brightness tends to increase to a certain extent with the free cyanide content. Increasing temperature will help to brighten the plate when it appears to be too much on the white side of the range. We have preferred to operate at room temperature, sacrificing increased production in order to maintain temperature with the least amount of equipment and operator attention. The tank used was rubber lined and equipped with an iron steam coil. Heat was applied occasionally to brighten the plate when necessary for the then existing conditions; thus the operator was allowed a further ready means of control.

Unquestionably, for the most uniform, smooth finish, the solution must be clean. For this reason the solution was filtered continuously and this procedure is very definitely and highly recommended by the author. Further, agitation of the work gives a considerably superior product. This was soon apparent in experimental work and hence the production tank was equipped with a cathode rod agitator. Definite precautions were taken to insure positive, continuous contact to the cathode bar. In addition, it was found that rigidly attaching the rack to the cathode bar so as to force it to move through the solution in

a definite, deliberate manner, gives more uniform results than allowing the rack to simply trail after the rod in a somewhat aimless fashion.

Anode to cathode distance is very important and should certainly not be less than six inches, and nine inches to the nearest cathode point is highly desirable, since again greater uniformity is obtained. The reason for this is a well known principle of electroplating. There was no interest in covering the inside of these articles, so racks were designed to facilitate placing the toaster housings back to back thereby shading the inside surfaces. While some silver was deposited it was less than we obtained by single racking and the symmetry of back to back racking also enhanced the uniformity of the plate.

On occasion, a peculiar brown staining was encountered on the work as it left the tank, but it did not seem to exert any objectionable effect on the final product, disappearing as it did during the subsequent firing operation. Tarnishing of the silver likewise appears to have no effect on the final finish. In fact a panel coated with silver and oxidized in a polysulphide solution went through the enameling operation to produce a finish identical to a companion panel which was not oxidized. Finger printing if very mild may not be objectionable but due to the variety of staining possible it is the safer course to completely avoid such by requiring all operators to wear cotton gloves.

After rinsing and drying without blowing off with air, the work should immediately start through the enameling operation, otherwise, it should be wrapped in the ordinary grade of soft tissue paper. Care should be exercised to prevent parts from rubbing against each other to such an extent that the areas of contact will become burnished.

The adherence of the enamel appears to be due to several factors. Thickness of coating is quite important, the optimum value being .005″ - .007″. As the thickness of enamel increases, the flexibility of the product decreases, ignoring for the moment the operational factors of applying and fusing it. The Harshaw Chemical Company recommends approximately 2 oz./sq.ft. of coating. In addition to having developed a glass with a high refractive index the ceramist appears to have obtained some

degree of flexibility, although this factor in part is determined by the time and temperature of firing. The mechanical and thermal shock resistance may be further explained by the fact that the glass coating is approximately half as thick as the usual good vitreous enamel coating. This in turn is made possible by the fact that the underlying silver coating functions to replace the Cobalt ground coat required in vitreous enameling practice.

Application is made by suspending the powdered glass in water and then spraying the suspension onto the work. Since clays must be absent, a gum is used to thicken the mix. Although a gum is used, there is still some difficulty in keeping the enamel in uniform suspension unless there is good continuous agitation, and to a greater degree than is employed in the usual vitreous enameling process. With small volume application from the can type of gun the agitation is not so critical, but for large scale work the large agitator type of tank is to be preferred. Having once made up the proper consistency of mixture and adjusted the spray gun for best application it is highly important to be sure that no settling of the glass will occur. For example — spraying may start satisfactorily but as settling occurs the operator will be applying a heavier coating of frit, which will cause several bad conditions to arise. During the firing operation the coating will sag badly and/or it may have considerable opacity and a proper luster of plate may be completely nullified, as subsequently pointed out. When the operator finally discovers that he is spraying a heavy mixture he will probably thoroughly agitate the mixture with the result that he will then spray a thinner and wetter mixture than the original. Thin coatings which result in fused coatings less than .003″ - .004″ thick seem to open up during the firing into a wide variety of small and large craters. In some cases oxidation then takes place causing varying sizes of blisters in the silver plate. It is interesting to note that there appears to be no trouble from blistering if the sprayed frit coating is thick enough.

Clarification should be made at this point between thick and thin coatings, and wet and dry coatings since it is possible to have any combination of thickness and wetness of coating. A heavy (large quantity of enamel) coating which is fairly dry when applied will perform as described above but, if it is quite

wet, it may sag before it is fired. This is particularly true if the work moves to and through the furnace on a monorail conveyor, where there may be considerable vibration of small magnitude. A thin dry coating may pull apart or crater during firing, while a wet coating may pull apart before firing or result in heavy and light areas after firing, with the thin areas, more often than not, pulling apart or cratering. An understanding of these facts must be kept in mind in adjusting the consistency of the mix initially and in adjusting the spray gun. The above adjustments must be such as to produce a coating, immediately after spraying, which is uniform and slightly more than damp. Some guidance may be obtained by attempting to obtain a mixture which, when sprayed, will somewhat more than momentarily glisten in the area directly under the gun. If the work after spraying has a watery luster, it is probably too wet; on the other hand, it should not be so dry as to be dusty.

The process is particularly appealing in another respect, namely, selection of colors. It is possible to obtain a wide variety of colors in almost any shade desired. This should be of considerable interest to product designers and sales departments since it permits yearly changes in styling with a minimum rearrangement of factory processing. In this pilot work it was considered advisable to apply the clear untinted glass until more experience was gained. It was soon noticed that the operator was experiencing difficulty in getting uniform coverage when spraying the white frit over the semi-lustrous white Silver surface. This difficulty was remedied by the addition of a small amount of an organic dye to the suspension.

Reclaiming of the overspray presents a rather difficult problem, one which was not solved in the duration of this pilot processing. The difficulty was caused by the use of a conventional vitreous enameling spray booth. Difficulty in this direction is due mainly to the fact that the smallest of foreign bodies are readily detectable in the clear glass coating over the semi-lustrous surface, so much so that one might safely say that such particles must be almost entirely absent. Thus it is readily apparent for any successful approach toward reclamation there must be absolute cleanliness in every detail, the booth must be streamlined, and the room air sealed and air conditioned. Since

no specific study was made of this problem there are unquestionably other contributing factors which are unknown to the author. Suffice to say that for economical operation, recovery of the over spray must be considered.

Fusion of the coating may be accomplished at 1475° F. in any of the usual vitreous enameling furnaces. A short period of drying before firing is beneficial. Although five minutes is the nominal time this factor is variable. Likewise, the temperature may be variable. In some cases a variation of either or both of the above factors may be utilized to overcome a slight opacity or improve the flow out of the enamel. Opacity in this instance is generally due to the inclusion of a multitude of minute gas bubbles within the body of the coating and may be minimized by allowing slightly more time for the firing operation or by increasing the temperature. However, too long a time or too high a temperature must be guarded against, since such excesses may cause the enamel to attack the steel through thin spots in the silver coating, and/or the enamel will tend to pull away from the edges. A little preliminary experimentation to determine the minimum for these factors for a given standard of quality will result in better production with fewer rejects. A properly fused coating will have a minimum of gas bubbles and will be quite smooth with very little or no "orange peel" noticeable. Sandy or pebbly areas which may have a yellow or light brown color are due to a slight insufficiency of enamel and oftimes may be salvaged by respraying in that area, mist coating the part all over and then refiring.

Care should be taken to suspend or support the work so that the minimum of strain will be exerted upon it during the firing operation. There is a noticeable advantage in the fact that fusing may be accomplished at a temperature somewhat further below the sagging temperature of steel than is the case with conventional vitreous enameling. No opportunities should be present for the dropping of scale, refactory dust, or other foreign particles, on the work. In this instance the parts were passed through the furnace up side down with noticeable improvement in the cleanliness of the finished surface. Screw holes which are to be subsequently covered should be lightly cleaned of frit at the edge before firing, and if the tolerance is close, of course will

have to be opened in designing to compensate for the approximate .010" decrease in diameter.

In designing for this process, steps should be taken to avoid sharp internal angles such as exist at the end of slots. Flanges and the like should not be made with a sharp radius. Embossings and engravings must not be too delicate or they are very apt to be almost obliterated by the coating. In addition, great care must be exercised to insure the absence of dirt and burrs in and at the base of these markings. Since this must for the main part be taken care of in preparation for plating, the cleaning cycle is thus made somewhat more critical than that required for plain unmarked surfaces.

In this, as in all new processes there are production problems which encourage the adventurous finisher, challenge the ingenious, intrigue the commercially minded. Likewise there are proportionate rewards for the capable and patient operator. Some attempt has been made here to pass along the knowledge gained on one installation. If we recognize the fact that each installation is characterized by its own peculiarities then we can also realize that there may be other benefits and problems not here mentioned or encountered. Certainly it is a process which in some fields is befitting of the better world we are now fighting for.

ANNUAL DECEMBER EDUCATIONAL SESSION AND BANQUET OF THE A.E.S. DETROIT BRANCH

On the basis that "All work and no play makes Jack a dull boy," the Detroit Branch A. E. S. will hold its Annual December Educational Session and Banquet on Saturday, December 5th, 1942, at Hotel Statler, Detroit.

We will have four speakers for the afternoon session starting at 2:00 P. M., with Mr. Wm. Phillips, General Motors Corporation, as chairman:

(1) Dr. Ralph Lee, General Motors Corporation, will talk on "Human Engineering."

(2) Lieut. J. Teres, Army Air Corps, Wright Field, will present his paper, "Metal Finishing for Military Aircraft." This paper was given at Grand Rapids and we think it is worth repeating at Detroit.

(3) Mr. T. G. Coyle, United Chromium, Inc., will have as his subject, "Hard Chrome Plating."

(4) Mr. H. G. Moak, Chrysler Corporation, will talk on "Imagineering."

An analysis shows that with two technical papers and two general subjects, we will have a well balanced program.

At 7:00 P.M. we will have the usual banquet and entertainment, with dancing until ———. In order to streamline our program with the times, we will not have the frills that we have had, such as elaborate decorations and program. Also, in view of rising costs, we have had to set the price of tickets at $5.00 each to keep our high standard of food and entertainment.

WRIGHT W. WILSON, *Acting Secy.-Treas.*

RESEARCH COMMITTEE

We want to remind the members at this time that there is still an opening for a Research Associate at the National Bureau of Standards. Mr. Lux resigned the first of September to go into Industry and an opening still exists. The progress of the work up to now has not suffered particularly, but the Research Committee feels that it is essential to get a new associate working on their problems at an early date. We urge anyone who is interested in such a position to get in touch with either Dr. Blum at the National Bureau of Standards or Mr. Thomas Slattery of the National Bureau of Engraving and Printing.

This is an unusual opportunity to work in Plating Research under the direction of Dr. Blum who has worked on Plating Problems for many years and is eminently qualified to conduct such work. In addition to the direction of Dr. Blum, is the opportunity to consult with men in other branches of the National Bureau of Standards making it an excellent opportunity to broaden one's outlook on all phases in Science and Engineering.

E. T. CANDEE.

THALACKER BECOMES GENERAL MANAGER DETROIT REX

The Detroit Rex Products Company has announced the appointment of A. O. Thalacker as General Manager. Mr. Thalacker has been a company executive for the last five years and lately has been Secretary, a position he retains in addition to his new responsibility.

The metal cleaning process in which the Detroit Rex Products Company is now principally interested has resulted in a quadrupling of its business in the last eighteen months. This new appointment will further streamline its war program.

NEWS ITEM

Robert W. Benton has become affiliated with The Lea Manufacturing Co., of Waterbury, Conn., to work as Field Consultant in furtherance of the use of Lea Compound and allied products for burring and polishing in the war industries. The Lea Method of Burring is known widely throughout the metal industries and its use is particularly effective on Ordnance parts, motor parts and aviation accessories.

Mr. Renton has represented The J. B. Ford Sales Co. for several years in the Ohio area and his efforts in his new connection will be in the middle west, chiefly in the state of Ohio.

Business and Social News

BRANCH NEWS

Educational Activities

AMERICAN ELECTROPLATERS' SOCIETY

New Haven Branch held its first meeting of the 1942-1943 year in the Sterling Chemistry Laboratory of the Yale University on October 6. This was the first meeting of the combined educational and business sessions which have been decided upon for the present year. Meetings are now to be reduced to only one meeting a month with a short business session to precede the educational session.

In the absence of President Clarence Garner, Ed Luther conducted the business session and later introduced the speaker. The principal business at this meeting was the bringing up to date of the branch membership. The secretary read and the members accepted the letters of resignation from three members and also one application for membership was introduced. Then Vernon Julianne submitted an application for transferal of membership to the Philadelphia Branch. After the reports of the various committees the business meeting was considered closed.

The presiding officer then introduced the speaker of the evening, Mr. J. C. Donahue, Sales Manager of the Abbott Ball Co., Hartford, Conn. Mr. Donahue, is also president of the Hartford branch and plays an active part in A.E.S. activities. The subject which the speaker chose was "Barrel Finishings of Rough Castings and Forgings," but he spoke about the entire principles and field of barrel finishing.

The first part of the talk stressed the necessity of having a full understanding of fundamentals involved in barrel finishing. There are two distinct types of barrel work, namely, cutting down work in which some abrasive and carrier are added to the barrel, and ball burnishing for a finished shiny surface. At the present time the cutting down operation is most important because war finishes do not stress beauty in the finished product.

In attacking a barrel finishing problem there are four main points to decide (1) Type of barrel to be used (2)Speed at which barrel is to run (3)Length of time to run (4)The abrasive or pins which are to be used. It is also important to keep accurate records of developments carried out so that a decision may be made more easily. In forgings the condition of the dies is very important because it will govern the size of the flash on the product to be rolled. To improve the finish on casting work it is sometimes necessary to do a wheel operation before rolling, and also if very fine sand is used in making the molding then barrel finishing will be more able to give a fine finished product.

After the talk Mr. Donahue answered many questions which were asked by the audience. Mr. Joseph Downes, who was warmly welcomed on his return to the meetings of the New Haven Branch, asked numerous questions and also aided the speaker to answer some questions. He was particularly impressive with figures he quoted on the way barrel finishing is replacing buffing in numerous operations. The meeting closed at approxi-

They Have to Be TOUGH

Men who tame and train the wild bronchos have to be tough all over. Weak joints won't withstand the wear and tear that go with this job. Tanks and accessories for plating service have to be tough, too. A weak joint will soon become a leak point when the forces of corrosion go to work. That is why Storts-welded tanks are preferred by buyers who are trying always to keep production going and to avoid oft-recurring replacement expense.

STORTS WELDING COMPANY

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Manufacturers of Welded Fabrications to Specification

PENNSALT CLEANER

(REG. U. S. PAT. OFF.)

On U. S. Army tanks, the rims of the "bogie wheels" are brass-plated before their rubber "shoes" are put on. If the brass-plating is unsatisfactory, a poor rubber-coating job results.

A manufacturer had the problem of stripping unsatisfactory brass-plating from the tank rims. He was using a boiling chromic acid bath, but the job took an hour and entailed considerable evaporation of the acid. Since chromic acid is on priority, he wanted to speed up the operation in order to conserve this critical material.

A Penn Salt representative saw that a Pennsalt Cleaner could help. Result? The Pennsalt Cleaner stripped the brass in one-fourth the time formerly required, and cut down the time in chromic acid to *one-fifteenth*, thus effecting a substantial reduction in the chromic acid lost by evaporation. It did everything the customer needed, from a brass-removing standpoint, and subsequent re-plating of the rims was entirely satisfactory.

This was a tough problem to solve, but Penn Salt engineering, backed by the complete line of Pennsalt Cleaners, was equal to the task. In the family of Pennsalt Cleaners, there is at least one which will facilitate some metal cleaning operation in your plant. Let the Penn Salt technical staff help you with your problem. Phone or write to Pennsalt Cleaner Division, Dept. MR.

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mately 10:00 o'clock after a rising vote of thanks was extended to Mr. Donahue for his fine speech.

WALTER T. LYNCH, *Secy.*

Toronto Branch. The regular meeting was held on October 9th at the Royal York Hotel with President Boaz in the chair and 37 members in attendance to hear final preparations for joint meeting at General Brock Hotel, Niagara Falls, October 24th.

One application and one resignation were accepted while Mr. John Condon and Mr. Charles Reed were elected into membership.

Mr. Art Sences read a letter from Mr. Caldwell and Chairman Boaz called on Mr. John Acheson as Speaker of the evening, his subject being "A Plater's Responsibility in the Conservation of Metals." Mr. Acheson had this down pat, he told us things we already knew in the matter of waste salts, etc. but he emphasized the fact that this conservation had to be done, else we would all be out of a job as far as plating was concerned. He spoke on uncoated racks; drips and articles with pockets were all wasteful in the drag out, that one concern that he knew had lost a whole tank full of solution in one year through careless drag out. He spoke of racks that shaded the work and if racks were not coated and not made right between the shading and uncoated racks we had a 10% waste in every tank load. He also showed samples of Zinc barrel hangers and nickel racks that had also been used as dummys which were splendid specimens for a museum. Mr. Acheson answered many questions and received a hearty vote of thanks from the members.

JAMES S. CAIRNS, *Secy.*

FOR SPEED TO MEET THE SCHEDULE!

Hammond

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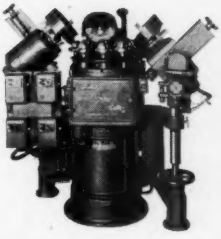

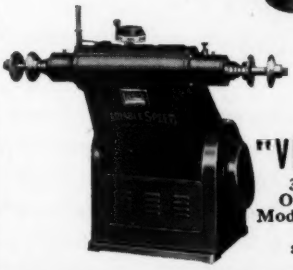

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HOW would you remove the burrs on a gear such as illustrated? By fil
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Recently a manufacturer sent us a large alloy steel bevel gear for our rec
mendations as to how to remove the burrs. After considerable study
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METHODS

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rejections, and work with closer pecision. Or, if you have a polishing operation that isn't going too well, remember that Lea Technicians are the metal industry's specialists in polishing. Write us in detail about your burring or polishing problem. Send sample of the work, if practicable.

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11-LM-2

St. Louis Branch held its regular monthly meeting Monday, October 5th, 1942 at Central Y.M.C.A.

Dinner was served to 25 members after which President Musick called. There was no reading of minutes due to the fact the secretary forgot them.

One application was read to be acted on at our next meeting.

Letter read from Electro Chemical Society inviting the platers to attend their meeting in Detroit this month.

It was with regret that we read about the death of Mr. W. J. R. Kennedy. Our sympathy to Mrs. Kennedy.

There being nothing further, the meeting was turned over to our Librarian, Professor R. M. Errington, who in turn introduced Mr. Stuart Krentel, representative of MacDermid Inc. of Waterbury, Conn.

Stuart said Professor Errington called him up and asked him if he would give a talk at St. Louis. Stuart said what will I talk about. Professor said about 15 minutes. So here I am. The subject will be "Electroplating in War Industry."

Mr. Krentel stated that there was plenty of work in job shops as long as they could give deliveries and do quality work. He spoke of one small firm which was doing a large volume of work in jars, but was doing real quality work. He also spoke of bright copper plating in acid bath which was very interesting. He also spoke of releasing the stress on springs by baking.

Prof. Errington then asked if there were any questions. There were some asked which Mr. Krentel answered to everyones satisfaction. At this time, the MacDermid Co. was thanked for the talk by Mr. Krentel, and also Professor R. M. Errington for making this talk possible.

Professor Errington is with the La Salco Co. of St. Louis. Motion made to give Mr. Krentel a rising vote of thanks.

Do not know the speaker for next meeting but you can be sure it will be good so put that down in the little black book. (2nd of Nov.).

Meeting adjourned.

CHARLES T. MCGINLEY, *Secy.*

Newark Branch held its regular meeting on Friday evening, September 18 at the Hotel Robert Treat, Newark, N. J. The meeting was called to order at 8:30 P. M. with President William Bruhns presiding. Other officers present were: Robert R. Sizelove, 1st Vice-Pres.; Louis Donroe, 2nd Vice-Pres.; George Wagner, Sec'y.-Treas.; John DeVries, Sgt.-at-Arms,; Horace H. Smith, Board of Managers.

The minutes of the previous meeting were read and approved.

Under Committee reports, Mr.

Advantages of 99.925% pure Copper Anodes

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4. No spotting or discoloration.
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Horace Smith announced that arrangements were being made for a Christmas Party to be held at the Hotel Robert Treat on December 19. The admission to this party will be increased by approximately 50c per member, over last year's admission price which was $1.00. The admission to outsiders will be decided upon by the Committee at a later date.

Mr. Louis Donroe, acting Librarian, presented Mr. Adolph Bregmann as the guest speaker for the evening. His subject was "Cost Finding". Mr. Bergmann told us of the experience he encountered with a group of members of the Master Platers Association, where articles for plating were given to one group of seven and another group of nine members for quotations. On one article which was being polished and plated for 5c, the quotations varied from 2c to 9c and on other articles which were of a higher price the variation on the quotations were about the same ratio. After spending considerable time on "Cost Finding" the Association has agreed on a system based on an hourly rate per work hour which now is of great assistance to the members. Mr. Bregmann was given a rising vote of thanks by the 37 members who attended.

Meeting adjourned at 10:30 P. M.

GEORGE WAGNER, *Secy.*

Grand Rapids Branch continued its meetings September 11th and meetings will be held every second Friday of the month at the Rowe Hotel. The meeting was opened promptly at eight o'clock by our President, Maurice Caldwell.

Communications were read and approved. Financial reports were given of the Branch and also the Convention held here last June showing a substantial financial gain for this Society.

Now Mr. Plater

Now . . . like never before, time is precious and critical materials are needed. Use D'OILERS. Use trouble free D'OILENE and TROMEX degreasing solvents and you save time and material.

DRUMS are scarce . . . treat them with care and return promptly. Save dirty sludge. We can reclaim the solvent for you.

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A motion was made and approved by this Branch that they contribute one dollar per each member to carry on the research work of the Research Associates.

Election of officers then took place and the following new officers for the year were elected.

President—Homer G. Morton
1st Vice Pres.—Maurice R. Caldwell
2nd Vice Pres.—Stewart Z. Martin
Sec'y.-Treas.—C. E. Abel
Librarian—Ivan Hepfer
Board of Managers:
Maurice R. Caldwell,
James B. Haviland,
Jack J. Hanney.

Those leaving offices expressed their gratitude and appreciation for the splendid help and cooperation given by committees and all members the past year.

The meeting was then turned over

to the Librarian and the moving pictures of the Convention held here in June were shown.

A discussion then took place as to what educational program should be carried out for the balance of the year and decided upon and the meeting was adjourned. C. E. ABEL, *Secy.-Treas.*

Bridgeport Branch held its regular monthly meeting on September 4, 1942 at 8:00 P. M. at the Stratfield Hotel. President Charles McElroy opened the meeting with nineteen members present.

The roll call of officers was read and John Schneider and B. F. Kusterer were reported absent. The minutes of the previous meeting were read and accepted.

Reports of Special Committees:

J. G. Sterling reported that a check for $40.11 was received from Apley N. Austin, treasurer of the Regional Meeting Committee.

Arthur R. McNeil, Chairman of the Outing Committee, gave us a full report on the outing to be held Saturday, September 5, 1942, at Trumbull, Conn., at the estate of Wm. A. Ehrencrona.

Reports of Standing Committees:

Clarence C. Helmle, Supreme 3rd Vice President, reported the sad news of the demise of our beloved Supreme Secretary and Treasurer, Wm. J. R. Kennedy. It is needless to state our emotions at hearing the sad news. The members of the Branch stood up in silent reverence in memory of a person who was beloved by all who knew him. Dr. Walter R. Meyer and Clarence C. Helmle attended the funeral at Springfield, Mass. A floral offering was sent by the Branch to the bereaved family.

Report of Membership Committee:

R. J. O'Connor, Chairman of the Membership Committee, reported favorable results.

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A simple, easy to operate "**One Bath** process" for blacking steel and iron.

Government approved on any contract requiring a black oxide finish.

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Communications:

A letter from Supreme 1st Vice President, George J. Wagner, regarding speakers for our Educational Sessions was turned over to our Librarian, C. C. Helmle.

A letter from the Colonial Alloy Co. was also turned over to our librarian.

Applications for Membership:

None.

Balloting for Membership:

Carleton H. Deuter, Associate member, General Electric Co., Bridgeport, Conn.; Eugene P. Schimmel, Associate member, Bassick Co., Bridgeport, Conn.

Unfinished Business:

None.

New Business:

John Deamico was reinstated as associate member.

A motion was made and passed re-

garding the possible purchase of a film projector. A committee was named by President Charles McElroy to make an investigation of such a purchase, and giving authority to the committee to spend not more than $250.00. The committee members are as follows: Ralph McCahan, Dr. Walter R. Meyer, Clarence C. Helmle, Arthur R. McNeil.

Bills against the Branch:

None.

Good of the Order:

The members of the Branch accepted a fine report pertaining to our librarian, Clarence C. Helmle, who now is also our Supreme 3rd Vice President. We are proud "Chick" and we know you can handle the job with grace and dignity.

A report of the National Convention was received from the delegates. The pros and cons of the amendment proposed at the convention was discussed. It was agreed that this subject should, and will be, discussed frequently during the coming year in an effort to develop some constructive suggestions to satisfactorily bring the "New" and the "Old" together in the Society.

The treasurers report was read and accepted.

Th3 meeting adjourned at 10:45 P.M.

The meeting adjourned at 10:45 P. M. J. G. Sterling, *Secy.-Treas.*

Baltimore-Washington Branch.

The first regular monthly meeting of the Branch for the 1942-43 season was held on October 3rd., at Telelord's Buffeteria. President Warnock opened the meeting and introduced two of the guests present, Mrs. Polly Burkhead and Miss Carolyn Brooks, who have recently begun work in the Electroplating Section at the National Bureau of Standards.

Mr. Cappe of the Membership Committee presented ten applications of prospective members. It was voted to hold an annual educational session and banquet this year.

Dr. Kenneth A. Graham, the guest speaker, was introduced by Dr. Vernon A. Lamb, Librarian, and he spoke on "Black Oxide Finishes." The following is a brief resume of Dr. Graham's talk. He gave a detailed account of the alkaline nitrite and nitrate baths. The corrosion resistance of the coatings is dependent on the type of oil used. Certain oils will give the coatings a life of 300-600 hours in the salt spray. Of the oils used, straight mineral oils are the poorest, and soluble oils are the best. The black film may be produced by either a one or two bath treatment, but the latter produces the heavier film. Too long a treatment in the bath produces a smut on the steel and an unsatisfactory

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*See article in June MONTHLY REVIEW page 493.

color. Specifications for black oxide coatings should provide for a salt spray test of the film, coated with that type of oil with which it will be coated in actual service. The quality of the oxide film can be evaluated by an abrasion test in the unoiled condition.

ALBERT BRENNER, *Secy.-Treas.*

Boston Branch. The Branch met at the Statler Hotel on October 1st. President George P. Swift presided. It was voted to extend the sincere sympathy of the Branch to the family of our late Executive-Secretary, William J. R. Kennedy in their recent bereavement.

After the regular order of business, the two speakers for the evening, Ralph H. McCahan and William Starr were introduced by Louis Gagnon, Librarian. Mr. McCahan, of the Du Pont Company, spoke on "Bright Zinc Plating." A resume of the questions and answers will be sent later to the REVIEW.

Mr. Starr outlined the "Current War Production Board Regulations Which Affect the Plating Industry." The information was helpful and there were many questions.

Among the many visitors were our friends Frank Clark and Dr. Kelner.

A. W. GARRETT, *Secy.-Treas.*

Chicago Branch. The regular monthly meeting of the Branch was held on October 9th at the Atlantic Hotel.

President F. K. Savage presided and all officers were present. After the usual reports of committees a letter from M. R. Caldwell, National Vice-President and Chairman of Membership was read by R. J. Hazucha, who is in charge of the membership drive. A letter from the American Society for Metals inviting branch members to attend their meetings was read.

H. Rensburg, guest speaker of the evening, introduced by R. J. Hazucha, Librarian, spoke on the "Electro Depositing Paint Spray." As this method is new his talk was of especial interest to all in the spraying and enameling of metal industry.

H. A. Gilbertson reported progress being made for holding the annual educational session and banquet on Saturday, January 23, 1943, at the Palmer House.

A sound motion picture "Lead Milling, Smelting and Refining" was shown.

J. W. HANLON, *Secy.*

Cleveland Branch. At the meeting of the Branch on September 12th a report by the delegates to the annual convention in Grand Rapids, was given and it was apparent to all why the

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convention was so successful not only for the excellence of the papers given but the fine social program.

Stephen Miller gave a report on the Branch's annual outing on July 18th which showed a financial profit and was a huge success in every way.

Letters were read from Dr. E. M. Baker, National President of the Electrochemical Society and from Walter L. Pinner, Secretary of the Detroit Branch of the Society, inviting members to the fall meeting of their Society on October 7th.

A meeting was held at the Cleveland Hotel on October 3rd at which President William E. O'Berg presided. The usual reports of committees were given and after discussion it was decided to hold special meetings on nights when guest speakers are available.

George B. Svenson, *Secy.*

Pittsburgh Branch. The regular meeting of the Branch was held on October 1st at the Bureau of Mines Building, 4800 Forbes Street, where the meetings for the coming year will be held.

Following the business meeting, Myron Diggen of Hanson-Van Winkle-Munning Company, guest speaker, was introduced by R. A. Dimon, Librarian. Mr. Diggen gave a very interesting talk on "Zinc Plating and Its Relation to the War Effort." Following Mr. Diggen's talk, we heard a fascinating story of the work done by the Red Cross during the present crisis. FRANK R. KELLER, *Secy.*

Toledo Branch. The first regular meeting of the Branch in the new fiscal year was held in the offices of Michael Spanolis on the evening of September 3rd. Reports from committees were given. Because of the war effort, many members are working at night and not able to attend evening meetings. It was suggested that when Detroit has a special meeting with a speaker, groups of the local members might meet and go in such cars as were available to the Detroit meeting.

An invitation of the Electrochemical Society to attend their convention in Detroit was read. A motion to the effect that a member in the Armed Forces should be retained on the Branch list as an honorary member but dropped from the National Society for the duration was passed. The October meeting will be held in the office of Mr. Spanolis.

G. P. H. BERGEMAN, *Secy.*

Cincinnati Branch. The meeting held on September 24th at the Gibson

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Hotel was one of the best of the year, both from an educational point of view and in attendance. The meeting was dedicated to the "old timers." William B. Stoddard, speaker of the evening, who has spent some time in Russia, gave a most interesting talk from the practical and research angles. A discussion on the modern control of solutions was very interesting.

The membership drive is really going over and the branch expects a large increase in the coming year.

Charles C. Conley, National President, will be the speaker at the next meeting at the Gibson and members of all nearby branches are invited to attend.

AL. FOREMAN, *Secy.*

Toronto Branch. The regular monthly meeting of the Branch was held on October 9th at the Royal York Hotel with President Boaz in the chair. Final preparations on the joint meeting at Niagara Falls on October 24th were made. Reports from various committees were given.

John Acheson, the speaker of the evening, introduced by President Boaz, spoke on "A Plater's Responsibility in the Conservation of Metals." He emphasized the urgent need for conservation of metals. He spoke on "uncoated racks" and said drips and articles with pockets were all wasteful in the drag out; that one concern he knew of had lost a whole tankful of Sol in one year through careless drag out. He spoke of racks that shaded the work and if racks were not coated and not made right, between the shading and uncoated racks we had a 10% waste in every tank load. He showed samples of zinc barrel hangers and nickel racks that had also been used as dummys and they were splendid specimens for a museum. Mr. Acheson answered many questions and received a hearty vote of thanks from the members.

James S. Caitns, *Secy.*

Detroit Branch. President Fritts presided at the October meeting at which 200 were present, a pre-war time attendance.

After the usual business was transacted, a movie, "Unfinished Rainbows" was presented through the courtesy of the Aluminum Company of America. While viewing this splendid color picture we felt a renewed thankfulness to Charles Martin Hall for his untiring efforts and painstaking research which resulted in a commercial method for producing aluminum.

L. G. Tubbs, Chief Chemist of the Mutual Chemical Company of America, was the speaker of the evening and he spoke on "Anodic Treatment of Aluminum by the Chromic Acid Process." His talk was accompanied by slides giving factual data to substantiate the factors important in the operation of the chromic acid anodizing process. In the order of their importance, he listed pH. or Hydrogen Ion

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Concentration, Temperature, Bath Concentration, and Current Density. It seems as though if the pH. value is in the proper range the Bath Concentration, and Current Density may vary between wide limits, and yet produce a satisfactory oxide film. While the anodizing process is a film-forming process, there is also a counterfilm-destroying process going on at the same time. Hydrogen Ion Concentration or pH. and Temperature no doubt have an important bearing on the rate of film destroying accompanying the film formation.

In the discussion following, a number of clarifying points were brought our such as the fact that the pH. had to be controlled by additions of chromic acid up to a certain concentration, and in order to make further reductions in pH. value, it was necessary to draw off some of the olution, followed by further additions of chromic acid. Under no circumstances should sulphuric acid be used to reduce the pH. value.

The point was also brought out that the current densities given in the charts shown on the screen were average values, and that they did not measure the current surge produced when the process is started. In figuring on new motor generator equipment, it is necessary to take into account the initial current surge.

At the November 6th meeting W. M. Phillips and Frank Clifton, General Motors Corporation, will speak and the subject will be "Bright Copper Plating in Acid Baths." Movie: "Lubrication."

Hector Sez:

Detroit Branch was sorry that Mr. Roberts, of Anotreat, Inc., was unable to attend the October meeting and give the members pointers on Anodizing Supervision.

Mr. Tubbs, of Mutual Chemical Company, however, lengthened his talk to cover the whole evening, and no one went home disappointed as the program was up to the usual standard that Joe Hoefer has set.

The jinx on our movies still haunts us. If the machine works, someone kicks out the wall plug to stop operations. This time it was Ed. Hahn's small (?) size 10's.

I wonder if Cleve Nixon knows what time the meetings start, or did he come for the entertainment after the meeting?

Question: What does Carl Heussner like better than Baked Oysters, a la Statler?

Answer: Three more plates of the same.

Our Beau Brummel, George Nan-

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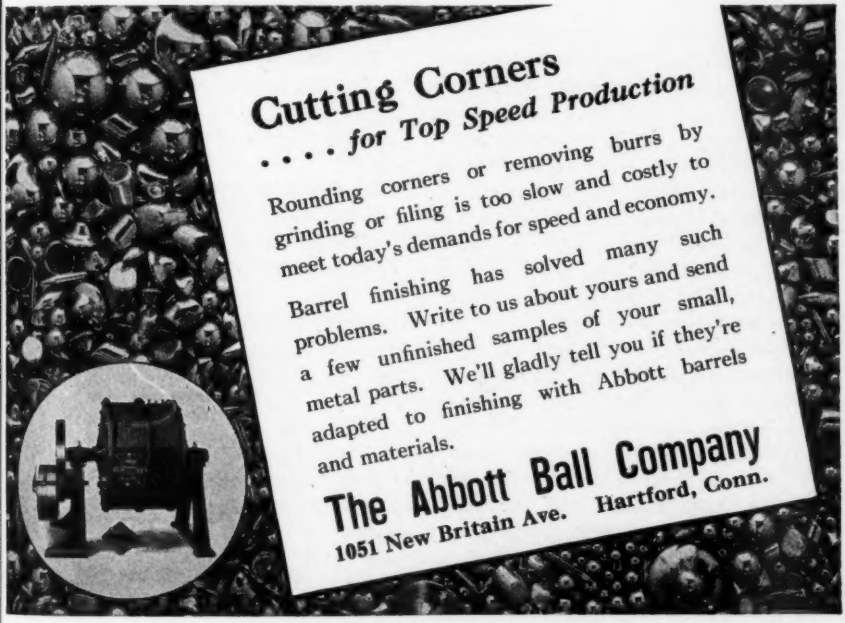
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kervis shows annually that he can be the perfect host to a bunch of Electroplaters. We do not believe that Jimmy Higgins appreciated this because of the fact that Jimmy gave half his lobster away. Perhaps 250 pounds of persuasion may have been the reason also.

Bridgeport Branch. The regular monthly meeting of the Bridgeport Branch was held October 2, at 8 P. M., at the Chamber of Commerce Rooms, Stratfield Hotel. President Charles McElroy opened the meeting with twenty-two members present. After the usual attention to business matters, Arthur McNeil and William Ehrencroma, of the Outing Committee, reported a good time was had by all who attended the outing at William Ehrencroma's estate in Trumbull, Conn., on September 5th.

Dr. Meyer, C. C. Helmle and Arthur McNeil gave us reports of the purchase of a film projector and have intimated that the purchase of this projector may be completed at the next meeting.

Eugene Phillips and Fred Gott Hardt reported the illness of William Flaherty and the members were requested to send personal cards to Bill—We may mention that Bill was glad to hear from the members and that his recovery from his illness is upward.

A letter from Acting Secretary, E. T. Candee, explaining the changes of business matters pertaining to official business of the branches and the Supreme Office was received. Some of the above matters are to be handled by Mr. Bain of New York City and Mr. E. T. Candee of Waterbury, Conn.

President Charles McElroy turned the meeting over to Librarian, C. C. Helmle, who gave us briefs, facts and activities done currently in the electroplating industry.

An open meeting was held on September 25, with Donald Wood as speaker of the evening. The meeting was opened with a general discussion by Mr. Wood of the Art and Science of silver plating. Later on open discussion was held which covered composition and characteristics of various solutions, government silver policy, specifications, corrosion resistance, deposition on various base metals with particular emphasis on steel.

There was little doubt that those in attendance found much to profit by in the meeting and all were grateful to Mr. Wood for his kindness in speaking to us.

JOSEPH G. STERLING, *Secy.-Treas.*

Los Angeles Branch. The regular monthly meeting of the Branch was held at the Rosslyn Hotel on October 14.

The meeting was called to order by President E. R. Holman. Frank Bunker was asked to serve as Sergeant-at-Arms in place of Stanley Rynkoff who was ill.

Mr. Bunker introduced the following visitors: Miss Evelyn Miller of Mueller Co., the first lady plater to attend one of our meetings; Mr. Baker of Mueller Co.; Mr. Hiller of Tropplet and Barton Lab. Inc., Mr. Dempsey, Adel Precision Co.,; Mr. Brown, Bendix Co.; Mr. Coleman, Square D Electric Co.; and Mr. Keith Brown of Turco Products Inc.

Marcus Rynkoff reported the death of Bert Chafin, an old friend of most of the members. Although not a member of the A.E.S., he attended most of the affairs sponsored by the Branch. He has been in the employ of the Liberty Plating Works as an all

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round helper for the past 18 years. He was 72 years old.

After the business meeting, Librarian ApRoberts introduced the first speaker of the evening, Robert Hiller, Chief Chemist for Triplett and Barton Lab. Inc., nationally recognized for their pioneer work in the X-Ray examination of metals. He gave us a talk on methods for control and analysis of aircraft plating which was very interesting. After discussion pro and con on the subject, Mr. ApRoberts introduced D. N. Eldred, Engineer of Electric Chemical Division of Du Pont Co., who gave us a very interesting talk on "Practical Tin Plating" and also furnished some plated samples showing time and heat changes which affect the plate. Both speakers were given a round of applause. I hope to have both papers for publication very soon.

C. C. McLaren, *Secy.*

Cincinnati Branch. The regular monthly meeting was held at the Hotel Gibson on October 22nd. It was well attended and we were glad to welcome a delegation from the Dayton Branch.

President Miesner presided and introduced the guest speakers, Charles C. Conley, National President, who gave a brief but very interesting talk, and Dr. Charles L. Faust of Battelle Institute of Columbus. Dr. Faust spoke on "Alloy Plating" and he showed many samples of his work on bearings which seems to be a new field for Electroplaters to work on. The subject was very interesting and Dr. Faust was still answering questions long after the meeting adjourned. Dr. Faust turned out to be a member of the Dayton Branch so we really had an unannounced regional meeting.

Bob Knoepler's Branch information service has been very successful and members telephone him for information on plating and finishing problems.

The Max Wocher & Cincinnati Plating Co. cups for the Membership Drive have got everybody working. The interesting speakers our President and Librarian, Bill Ehlen, have been getting have also produced new members.

Al Foreman, *Secy.*

Philadelphia Branch. President Verrell opened the regular meeting of the Branch and turned the gavel over to Librarian Henry G. Orlick. In the absence of the speaker, W. T. Mitman of the Aluminum Company of America, Mr. Orlick introduced the sound, technicolor film "Unfinished Rainbows," which is a very beautiful, romantic illustration of the modern method of producing aluminum. The story started in a modern laboratory, where a small class was saying there were no more inventions or discoveries to be made. The professor's answer was the story in the picture; how the discoverer, a man named Hall, developed the modern electrical method of m tallic aluminum manufacture. In almost every case, the original developers and their successors, had to start the actual manufacture of aluminum into useful articles; and so on down to the modern aeroplane in an effort to prove the usefulness of aluminum.

A discussion on the electroplaters quest on how to protect, through plating, aluminum and its various mixtures with other metals provoked a verbal tussle in which Al Hirsch, Geo. Gehling, Chas. Cahn and others took part.

It was voted to have a Social Night on November 21st, and to omit the regular monthly meeting for November.

The December meeting will be held

Facts about
Metal Polishing

Setting Up Abrasive Belts

MANY polishing operations are performed on endless canvas or leather belts set up with Alundum grain and an adhesive such as glue or polishing cement. When necessary the belts are recoated, usually by one of the following methods:

1. A suitable paste is made by adding abrasive grain to the adhesive, and if the latter is glue the grain should be preheated. For most polishing jobs the paste should contain the maximum amount of abrasive which will leave a workable consistency, when spread on the belts with a trowel, knife or brush.

2. Another method is to paint the belt with adhesive and sprinkle the abrasive on this surface. This method is satisfactory for many operations where the finer sizes of abrasive grain are employed. On severe polishing jobs with coarse abrasive grain it is necessary to press the grain more firmly into the adhesive by using a roller or similar device. Belts set up in sizes 60 and coarser with glue as the adhesive are often given a size coat, using a solution of 8 parts water and 1 part glue.

Coated belts should be dried under the same conditions outline for polishing wheels.

THE NORTON COMPANY, Worcester, Mas

G-144

NORTON ABRASIVES

on the 2nd Friday, December 11, inst ad of the 4th Friday.

On motion, the following Entertainment Committee was appointed to serve for the ensuing year: President Verrell, Art Sbow, Del Robson, Geo. Gehling, Gene Zurbach and Wm. Bantle.

In addition to the usual membership matters, the resignation of Wm. Braidwood of Barrhead, Scotland, due to retiring from the plating industry, was accepted with regret.

PAUL MENTZER, *Secy.*

Waterbury Branch. The regular monthly meeting was held on October 9 at the Hotel Elton following a dinner for twenty-one served in the Colonial Room.

President Ralph Colter opened the business and technical session with a showing of two interesting General Electric motion pictures, "Magic vs. Science," and "Curves of Color."

Dr. Dubpernell reveiwed the book, "Modern Electroplating," published by the Electrochemical Society. This book contains the latest information on the plating of alloys and metals. Each chapter is written by a specialist in his particular field and the whole book has b en carefully edited by Dr. Blum.

W. L. Cassell reported on the progress of the membership drive, noting that we are increasing our membership teadily.

W. D. Starr reported that $296 has been collected for the Research Fund to date, from manufacturers in this vicinity and from members. It is expected that Waterbury's efforts will net well over $300 for this important work.

It was with deep regret and sympathy for the family that we noted the death of Philip Bernier who, for a number of years owned and operated the Connecticut Electroplating Company.

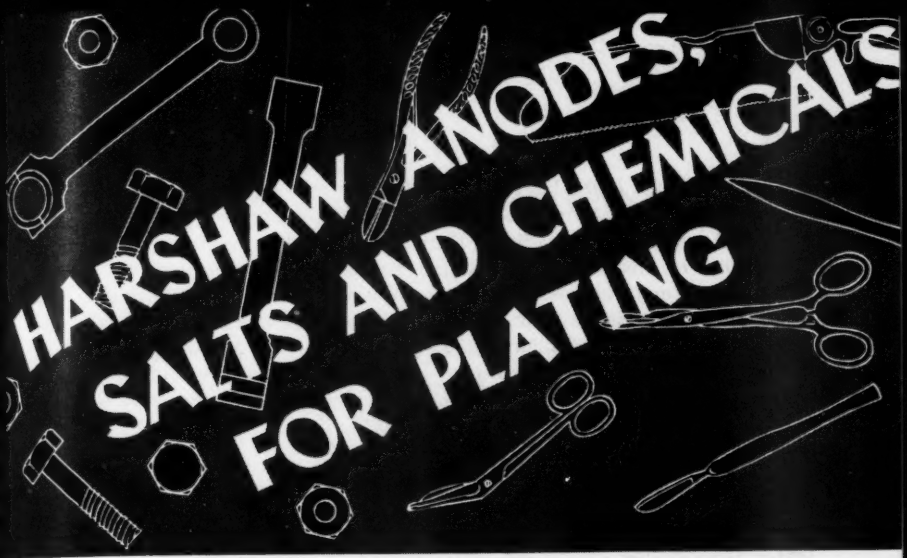
Our technical session was devoted to the research program, the purpose being to give our contributions and our members some conception of the scope and accomplishment of this work. Ellsworth Candee, as technical chairman gave us the history of the project since its inception fifteen years ago. Jo Downes speaking on the subject, "New Developments in the A. E.S. Research Program, elaborated Candee's remarks. Through this coordinated effort a great deal has been accomplished to increase our knowledge and to aid us in metal finishing and as the program develops and continues, information of increasing value will be obtained. Jo told us, too, something of his work at the Hamilton Propellor Company, where polishing of blades is done by skilled workmen with remarkable precision. We were all happy to have Jo with us again and to listen to his interesting and informative talk. We hope that during his stay in Hartford, he will be able to attend our meetings often.

The next business meeting will be held at the home of La Verne Verzier, Plank Road, Waterbury, Wednesday, October 28th.

SPENCER L. HENN, *Secy.*

Milwaukee Branch. The Milwaukee Branch met October 2nd at the Republic Hotel. The entire group spent a moment of silence in memory of Robert W. Shaffer who died last month.

The usual business meeting was dismissed in short order because of the members' desire to hear the educational feature of the evening. Librarian William Geissman introduced Frank MacIntyre of the Cleveland Research



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For Anodizing - - Use Harshaw Specification Chromic Acid.

PROMPT SERVICE AND TECHNICAL ASSISTANCE - - CONTACT HARSHAW FOR ALL PLATING MATERIALS

THE HARSHAW CHEMICAL COMPANY

Cleveland, Ohio and Principal Cities

Laboratory of E. I. du Pont de Nemours Company. Mr. MacIntyre spoke and gave a demonstration of the Hull Cell. He analyzed nickel, cadmium, brass, and zinc solutions that members brought from their plating rooms. His talk was very interesting and the large attendance listened attentively. Letters had been sent to many nearby concerns who engage in plating to inform them of Mr. MacIntyre's talk and many companies were represented. Frequent comments and questions interrupted Mr. MacIntyre showing the enthusiasm with which his information was received.

The Hull Cell is a very desirable, simple and reproducible plating test. It is possible with this instrument to secure absolute assurance of continued good solution operation by making routine tests. The determinations of organic addition agents and brighteners heretofore based on experience or occasional examination of the deposit can now be made accurately with the Hull Cell.

The meeting ended very late with the members bombarding Mr. MacIntyre with questions about the Cell that would do almost anything except sweep the floor.

JAMES DURNFORD, *Secy.-Treas.*

THE QUESTION BOX

Detroit Branch

1. *Can tanks used in anodizing be made wider to avoid using glass lining for insulation?*

Ans. In as much as the glass lining is merely used for insulation for the prevention of shorts, widening the tank would probably help. However, using more care in racking would accomplish the same purpose.

2. *In chromic acid anodizing is there an optimum ratio of anode to cathode surface?*

Ans. Since the load is usually a very small area compared with the anode it appears unlikely that such is the case. No one has ever reported difficulty because of this.

3. *What is a measure of the quality of an anodic film on aluminum?*

Ans. Government specifications usually insist on a 250 hour salt spray.

4. *Can chromic acid used in anodizing be recovered when the bath is spent?*

Ans. No method for doing this in the plant is known. However, if one feels economically justified, it can be returned to the manufacturers of chromic acid who may recover it.

5. *How is pH controlled in chromic acid anodizing?*

Ans. By discarding some of the bath and adding sufficient fresh chromic acid to bring pH down to desired value.

6. *What is the relative porosity of chromic acid film compared to sulphuric acid film on aluminum?*

Ans. So far as is known there is no difference in porosity.

7. *What causes a powdered finish on 24 ST aluminum rivets?*

Ans. This phenomenon is probably caused by too high temperature of bath or too high a pH.

EDGAR A. HAHN, *Librarian.*

Supplies *and* War Production

by W. D. STARR
THE LEA MFG. COMPANY

Critical metals such as Copper, Cadmium, and Nickel are further restricted so that even war work does not always qualify their use as plated coatings. It now becomes the ***kind*** of War work which determines whether the critical metal or a less scarce substitute shall be used.

Nickel has long been in this situation. It is common for a high priority requirement to be refused consideration by W.P.B. Persons having Nickel in active inventory may use it only according to Conservation Order M-6-b as amended Oct. 3rd. This provides that except where specifically authorized, nickel may be used only for implements of war and other products certified by the Army-Navy Munitions Board to be essential to the war effort.

Copper is highly restricted in use by Order M-9-c. Several amendments have been added to tighten the control and consumption. The reason for this will be apparent when we consider that a medium tank takes almost half a ton of copper; a big Flying Fortress over a ton and a half, and a battleship about two million pounds.

The Cadmium supply has been unsatisfactory for some time. Requests for allocation (on Form PD-441) have been allowed in quantities far exceeding the available supply. As this is contrary to the expressed policy of W.P.B., a change for the better may be expected soon. Meanwhile the trend is toward substitution with Zinc wherever possible. The Army Air Forces have already authorized Zinc in place of Cadmium on all non-structural parts over 1/16 inch thick, and future specifications will make this choice of metal optional. The switch to Zinc is urged in view of the scarcity of Cadmium.

Although Chromium as an alloying agent is critical, Chromic Acid for plating is easy to obtain and may be used with comparatively little restraint. Lead is seldom considered by the plating industry which is unfortunate because this metal is quite readily available. No future shortage is forseen as present control measures are regulating the output effectively.

Nickel Plating Magnesium Alloys. By W. S. LOOSE. *Trans. Electrochemical Society* **81,** (Preprint 6) (1942). Electroplating on magnesium alloys is difficult, probably because of a film of $Mg(OH)_2$ on the surface. Nickel plating baths recommended for plating on zinc are sufficiently acid to attack magnesium and deposit basic nickel and magnesium material as well as nickel plated by immersion on the metal surface. It has been found that a fluoborate solution is satisfactory for nickel plating on magnesium, but for good adhesion, the metal must be carefully prepared as follows:

1. Cathodic electrocleaning, 1 minute.

Sodium carbonate, $Na_2CO_3.10\ H_2O$	7.4 oz./gal.
Trisodium phosphate, $Na_3PO_4.12\ H_2O$	14.5 oz./gal.
Sodium hydroxide, NaOH	3.7 oz./gal.
Sodium metasilicate, Na_2SiO_3	7.4 oz./gal.
Sodium lauryl sulfate	0.9 oz./gal.
Current density	50 amp./sq. ft.
Temperature	158-194° F.

2. Rinse in hot water, then in cold water.

3. Chrome-Pickle Etch, 5 seconds.

Chromic acid, C.P. CrO_3	15.8 oz./gal.
Nitric acid, C.P., HNO_3	10.4 oz./gal.
Sulfuric acid, C.P., H_2SO_4	.007 oz./gal.
Room temperature.	

4. Cold rinse.

5. Modifying Acid Dip, 2-5 minutes.

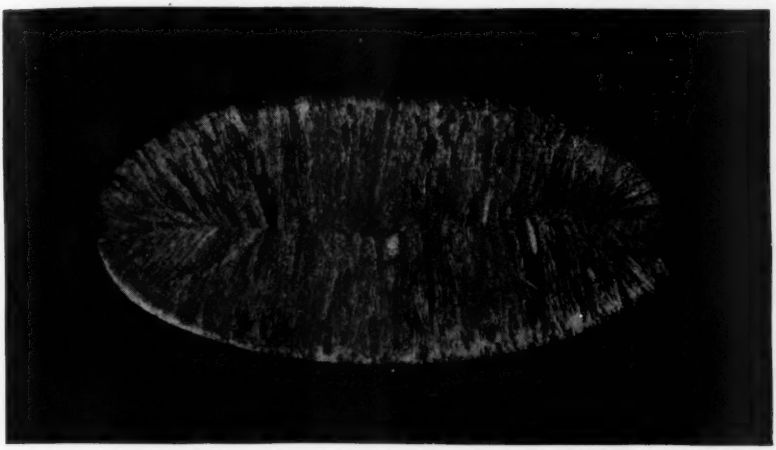
Hydrofluoric acid, 52% HF	22.0 oz./gal.
Nitric acid, C.P., HNO_3	1.1 oz./gal.

6. Cold rinse.

7. Nickel Plate.

Nickel sulfate, $NiSO_4.6H_2O$	7.9 oz./gal.
Boric acid, H_3BO_3	4.6 oz./gal.
Ammonium fluoride, NH_4F	8.8 oz./gal.
Hydrofluoric acid, 52% HF	to reduce pH to 5.5
Duponol ME	0.004 oz./gal.
Temperature	102° F.
Current density	10-30 amp./sq. ft.

To give the best results, the bath should have the following analysis:



An Anode with "Anchored" Grains!

LOOSE nickel in high acid or low pH baths is due to the attack of the acid on the bonding material, which isolates the nickel grains before they can dissolve. This is reduced to a minimum by the "anchored" spokelike grain structure of our "Seycast" 99%+ Pure Cast Nickel Anodes. The grains (see above) are long and narrow, extending to a common center. As the acid can penetrate only a slight distance between boundaries, the grains tend to remain solidly in place during the entire process of corrosion.

These anodes were designed primarily for Bright Nickel plating, but are excellent wherever uniform corrosion, smooth deposit and economical operation are important. They are recommended only for hot Watts baths having a pH of 4.5 (electrometric) or lower; that is, for high acid baths. Supplied as available under war allotment. Technical details on request.

SEYMOUR

"Seycast"

NICKEL ANODES

THE SEYMOUR MFG. CO., SEYMOUR, CONN.

Ni	1.77 oz./gal.
B (total)	.80 oz./gal.
F (total)	6.58 oz./gal.
Excess B	0.158 oz./gal.
Excess F	0.8 ± 0.1 oz./gal.

Excess boron is the amount above that required to combine as Ni $(BF_4)_2$. Excess fluorine is free fluorine above that required to combine with all the boron as BF_4- ions. In making up the bath, dissolve the NH_4F and H_3BO_3 first, and add enough HF to lower the pH to 5.8-6.0; then add $NiSO_4.6H_2O$, and adjust the pH to 5.5 with HF.

The chrome-pickle etch produces a slight etch; the sulfate content is important to obtain the best adhesion of the nickel plate. The use of ordinary sulfuric or muriatic acid dips apparently leaves a film of oxide on the metal which interferes with adhesion, but the chromic acid solution appears to remove the oxide film and replace it with a film of "reduced chromium oxide." This film is modified or removed in the HF-HNO_3 dip, and replaced by a film of magnesium flouride which either permits deposition of adherent nickel or is removed in the plating bath. Charts are given showing the variation of the deposits with bath constituents and plating conditions. The elimination of pitting is discussed. The bath should be filtered often, and activated charcoal may be used to remove organic matter which may cause hard, brittle plates. The nickel deposits may be stripped anodically in 25% HF and 5-10% HNO_3. When the nickel is completely removed, the current drops to zero, due to polarization by a film of MgF_2. Adhesion tests for the plate are described. Since magnesium alloys, like iron, are anodic to nickel, the plated magnesium will resist corrosion only if the deposit is free from porosity. Articles plated with nickel and chromium have withstood laboratory fumes for more than two years; die castings with 0.001" nickel will pit in a few hours of salt spray; nickel-cadmium-nickel triple plates, with total thickness .001-.0015", where the cadmium and final nickel have been buffed, have withstood about 20 hours salt spray. Magnesium alloys plated with .001" nickel may be safely used in atmospheres protected from excess moisture. It is believed that a complex nickel salt is formed in the bath, possibly $Ni(BF_4)_2$.

ERNEST H. LYONS, JR.

Cadmium Plating. By G. SODERBERG and L. R. WESTBROOK. *Trans. Electrochemical Society* **80** (Preprint 27) (1941). Cadmium plating affords corrosion protection together with attractive appearance on iron and steel, and brass and other metals and alloys as well. It is applied largely for indoor or sheltered use, but also for aircraft, marine, and military outdoor service. It is somewhat resistant to alkalies as in washing solutions and concrete, but not to other chemicals. On assemblies consisting of several metals, it minimizes voltaic-couple corrosion. For electrical parts, it is easily soldered to, and is serviceable on contacts. A historical account indicates that commercial cadmium plating dates from 1919. Acid cadmium baths are used only in electrowinning, since cyanide baths are superior in almost every characteristic for plating. The composition of the cyanide complex is uncertain. Since baths are usually made by dissolving cadmium oxide in sodium cyanide,

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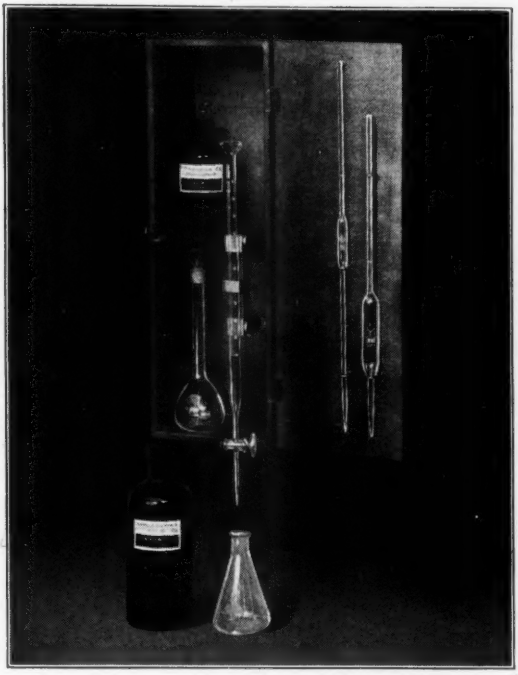

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an amount of sodium hydroxide equivalent to the cadmium (0.7 oz. of NaOH for each oz. Cd) is formed. The following baths are typical:

	Still plating	*Barrel plating*
Cadmium oxide, CdO	3 -5.2 oz./gal.	2.7-4.3 oz.gal.
as cadmium metal, Cd	2.5-4.5 "	2.3-4.8 "
Sodium cyanide	11.5-17.5 "	8.8-15. "
Temperature	68-95°F.	
Anode current density	not over 20 amp./sq. ft.	
Cathode current density	5-50 amp./sq. ft.	
Cathode current efficiency	85-98%	

The heavier cadmium conscentration are desirable for the higher current densities. The free sodium cyanide provides conductivity and makes anode corrosion possible; its concentration is usually 8-10 oz./gal. In some baths, the appearance of the plate depends on the ratio between total sodium cyanide and cadmium: R = NaCN/Cd = 3.3-4.1. Caustic soda helps to provide conductivity; its concentration is not critical but an excess should be avoided. Addition agents to give smooth, bright deposits include complex nitrogen-containing condensation products of high molecular weights, and certain sulfonic acids; in addition, nickel and cobalt salts are used for high current densities. The throwing power, covering power, and conductivity are good. Constant or frequent filtration is desirable, but usually not required. Pitting, rarely encountered, is usually the result of improper cleaning of the parts before plating. Traces of thallium, lead, antimony, arsenic, tin, and silver discolor the plate; they are removed by treating the bath with freshly precipitated cadmium sponge or zinc dust and filtration, or by electrolysis at low current densities. Sodium carbonate should not exceed 6 oz./gal. with 5 oz./gal. cadmium, or 11 oz./gal. with 2.5 oz./gal. cadmium; cooling the solution prevents carbonate formation; carbonate may be frozen out, or precipitated with calcium sulfate. The complete analytical procedures given recommend an electrolytic determination of cadmium, or, less accurately, a potassium ferro-cyanide titration, and a Volhard titration for cyanide. Cadmium anodes are chill cast, and should contain 99.9% cadmium, with silver+lead+tin 0.05% maximum; arsenic+antimony+thallium 0.005% maximum. Bearing scrap is not sufficiently pure. Anode polarization phenomena are described; anodes should have a gray, metallic appearance. Steel anodes, which are insoluble, are sometimes used. An increase in free cyanide raises the permissible anode current density, while increasing sodium carbonate lowers it. A cadmium anode cannot become completely inactive as long as there is a steel anode in parallel with it. Steel tanks are customary; contamination of the bath by chlorides may lead to corrosion of the steel. Conventional cleaning methods are suitable before plating. After plating, the coating is often finished by a 2-30 second *bright dip* in $\frac{1}{2}$-1% nitric acid, or 13 oz./gal. chromic acid with 0.14 fl. oz./gal. sulfuric acid. Buffing, ball-burnishing, lacquering, painting, and coloring of the cadmium plate are less common finishing methods which are described. Coating specifications are given; for coating thickness, the microscope test is standard but inconvenient, and the dropping test as described is generally used, although the magnetic methods are also suitable.

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ELECTROCHEMICAL SOCIETY MEETING
Detroit Mich., Oct. 7-10, 1942

The 1942 Fall meeting of the Electrochemical Society was held in Detroit, October 7 through 10. Four technical sessions were scheduled: one on "Theoretical Electrochemistry"; on one "Cells and Miscellaneous Topics;" two on "Modern Trends in Electroplating." The attention accorded papers on electroplating reflects the importance of the industry in the Detroit area, and in the whole War Production program.

Electroplating papers were selected on the basis of their relation of war-time utility:

"Electrodeposition of Hard Nickel"
W. A. Wesley and E. J. Roehl.

"Back Plating Nickel Solutions"
Oliver P. Watts.

"Control of Ammonia in the Electrodeposition of Brass"
J. H. Monaweck.

"Corrosion Resistance of Bright Dipped Cadmium Coatings"
Gustaf Soderberg.

"Tin Plating from the Potassium Stannate Bath"
F. A. Lowenheim and M. M. Sternfels.

"The Adherence of Thick Silver Plate on Steel"
H. L. Crosby and L. I. Gilbertson.

"The Mechanism of Bright Electroplating"
John A. Henricks.

"High Speed Analysis and Control of Plating Solutions"
Geo. Jernstedt.

"The Structure of Brush-plated Silver"
H. L. Crosby and L. I. Gilbertson.

Three papers on Electrodeposition of alloys of Tungsten, M. L. Holt, M. L. Nielson, and Rodney E. Black collaborating.

"Anodic Treatment of Plain Carbon Steels," by R. L. Imboden and R. S. Sibley, described techniques of electrochemical polishing of micrographic specimens.

In the group of papers on theoretical subjects many outstanding authors were presented: Charles Kasper, Malcolm Dole, Arthur A. Frost, Peter Debye, Kasimir Fajans, Oliver Johnson, H. A. Laitinen, Ralph Pearson, W. V. Evans, A. L. Ferguson, Myron B. Towns.

The biennial presentation of the Edward Goodrich Acheson Medal took place at a dinner honoring Dr. Charles Frederick Burgess. The Acheson Medal and Prize is the highest honorary award in Electrochemistry. In his acceptance address, Dr. Burgess pointed out that any successful enterprise must originate with an idea, and pass through successive stages of craftsmanship and industrial expansion before the final stage of refinement occurs in the form of scientific study of the processes involved. Dr. George W. Heise and Dr. Sydney D. Kirkpatrick presented the biographical background, and Edwin M. Baker, President of the Electrochemical Society, made the award to Dr. Burgess.

At a luncheon meeting, Dr. John J. Caton, Educational Director for the Chrysler Corporation, chose the subject; "Technical Education in War Time." In calling attention to some of the faults of our educational programs, Dr. Caton evaluated Wisdom and Understanding above Knowledge, and drew parallels with certain European nations whose atheistic approach to Science has contributed to World tragedy.

Entertainment features of the four-day meeting, arranged by the Detroit committee, were along lines familiar to all who have been their guests at Electroplaters' Conventions. Since industrial plants are generally inaccessible to visitors except on official business connected with War Production, the usual plant visits were replaced by inspection tours of the Detroit Art Center, and the General Motors War Exhibit.

In addition to the dinner-dance, a complimentary supper-dance and show were provided through the cooperation of a number of manufacturers.

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A Reminder

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DETREX METAL PARTS WASHERS

A new 24 page book is announced by the Detroit Rex Products Company, 13005 Hillview Avenue, Detroit, Michigan.

The various types of Detrex Washers manufactured for use with alkalin cleaning compounds, petroleum spirits and emulsion cleaners together with the many features of design and construction incorporated in these machines are pictured and described in detail. Special adaptations of this machinery for defense armament production, particularly in the aircraft industry are included. Four pages of the book are devoted to blue print type of assembly drawings covering in some detail the construction of washers using both belt and monorail conveyors.

Triad Alkali Cleaning and Stripping Compounds, supplied by this company for cleaning of metal parts and used in conjunction with the equipment described above are included. Detrex equipment built for degreasing, shot testing and other processing is also covered.

Copies of the booklet will be sent promptly, without obligation, when requested on company letterhead.

A NEW BOOKLET

This booklet, covering the complete line of Rackote plating insulations, has been prepared by the Rackote Division of Wyandotte Paint Products Company, Wyandotte, Michigan, and is ready for distribution now. A copy may be obtained by addressing a request to the company.

The booklet describes Rackote's plating insulations and stop-off lacquers with their particular resistance to specified plating solutions. A complete rackoteing service is maintained by the company . . . and a proffer of aid from its technical department to help you solve your plating insulation and masking problems.

The company points out that all its products are available for prompt shipment.

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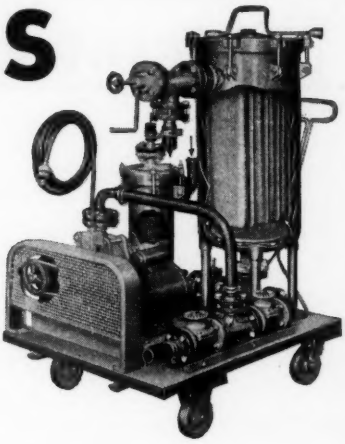

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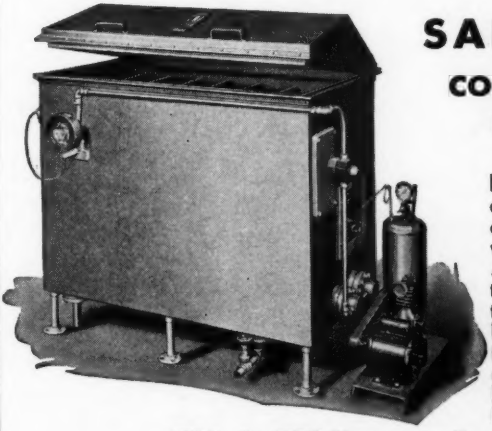

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CORROSION TEST EQUIPMENT

For testing—Electroplated or coated metals at 95 deg. Fah. in accordance with Army, Navy and Aeronautical specifications, as outlined in Bulletin AN-QQ-S-91-5 dated Dec. 1938. Also for controlled temperatures at any degree. Testing Cabinets lined throughout with rubber. Made in 4 sizes.

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MEMBERSHIP REPORT

MAURICE R. CALDWELL, *Chairman, Membership Committee*

To November 1, 1942

CHANGE OF STATUS

Bridgeport Branch

John Deamico reinstated as Associate

Detroit Branch

Wm. Hodson, Jr., from Associate to Active

Waterbury Branch

Patrick Vitello from Associate to Active

ELECTIONS

Cincinnati Branch

William Buchanan, 337 E. 3rd. St., Cincinnati, Ohio (Buchanan Supply Co.,) Associate

Harry L. Legg, The Cincinnati Ball Crank Co., Cincinnati, Ohio, Associate

Detroit Branch

Herberth E. Head, 5547 Fairview Ave., Detroit, Mich. (Briggs Mfg. Co.) Active

New Haven Branch

Augustine J. Carini, The Milford Rivet and Machine Co., Milford, Conn. Active

Pittsburgh Branch

B. F. Parlett, Jr., 604 Oliver Bldg.. Pittsburgh, Pa. (Hanson-Van Winkle-Munning Co.) Associate

Dr. L. E. Lancy, 229 Glen Ave., Ellwood City, Pa. (United Tube Corp.) Active

Toronto Branch

John Condon, 555 Logan Ave., Toronto, Ont. Associate

Charles R. Reed, 194 Rosemont Ave., Toronto, Ont. Associate

Waterbury Branch

Murray Beebe, c/o Lea Mfg. Co., Waterbury, Conn. Associate

John H. Ryan, 858 Main St., Watertown, Conn. Associate

Newark Branch

Kenneth J. Carson, 65 So. 7th St., Newark, N. J. (Western Electric Co., Inc.)

Walter Zitniak, 8 Roosevelt Ter., Irvington, N. J. (Foote, Pierson & Co.) Active

Los Angeles Branch

James Bell Houston, 119 N. Lincoln, Burbank, Calif. (Menasco Mfg. Co.) Active

Fred Leland Ferguson, 616 N. Durfee Ave., El Monte, Calif. (Square D Electric Co.) Active

MEMBERSHIP CAMPAIGN REPORT

BRANCH	May 1, 1942	Change in Membership	Percent Change
Cleveland	81	+14	+17.3
Indianapolis	48	+6	+12.5
Cincinnati	42	+3½	+ 8.3
Newark	156	+12	+ 7.7
Pittsburgh	52	+4	+ 7.7
Syracuse	31	+2	+ 6.5
San Francisco	46	+1	+ 2.2
Buffalo	55	+1	+ 1.8
Waterbury	97	+1½	+ 1.6
Bridgeport	80	+1	+1.25
Philadelphia	142	+½	+ 1.1
Toronto	87	+1	+ 1.1
Detroit	277	+3	+ 1.
Chicago	258	+1½	+ .6
Balt.-Washington	82	0	0
Binghamton	16	0	0
Lancaster	44	0	0
Prov.-Attleboro	49	0	0
Rochester	80	0	0
St. Louis	82	0	0
Grand Rapids	87	—1	— 1.1
Montreal	44	—½	— 1.1
New Haven	105	—1½	— 1.4
Dayton	99	—2	— 2.
Boston	118	—2½	— 2.1
Los Angeles	128	—3	— 2.3
New York	139	—4½	— 3.
Springfield	72	—2	— 3.
Milwaukee	97	—3½	— 3.6
Hartford	67	—4	— 6.
Anderson	38	—3	— 7.9
Toledo	46	—10	—21.8

NOTE: Honorary members are included with each Branch.

MEMBERSHIP — May 1st, 1942 = 2845
MEMBERSHIP — Nov. 1st, 1942 = 2860
GAIN IN MEMBERSHIP 15
GAIN = 53%

ELECTIONS

Milwaukee Branch

Lawrence J. Hay, 4029A N. 42nd. St., Milwaukee, Wis. (A. O. Smith Corp.) Active

Philadelphia Branch

Matthew J. Drozd, Associate
Stuart S. Kingsbury, Associate

APPLICATIONS

Baltimore-Washington Branch

Curtis K. Smoyer, Associate
Hiram Farrell, Associate
C. H. Singstack, Associate
James Edward Babcock, Associate
Lloyd Acton Taylor, Associate
Davif F. Wood, Associate
Howard E. Leannarda, Jr., Associate
Waring G. Myers, Associate
Leroy Russell Platt, Associate
Clifford E. Holden, Active
John J. Bognar, Active

Buffalo Branch

Newel Fiske Blackburn, 8091 W. Riverside Dr., Niagara Falls, N. Y., (E. I. duPont deNemours & Co.) Associate

Chicago Branch

F. A. Rudman, 3001 Engelke St., Houston, Texas
M. Brenan, 11206 S. Vernon Ave., Chicago, Ill.

Cincinnati Branch

Wm. Stewart Chipman, Chipman Supply Co., 1715 Elm St., Cincinnati, Ohio, Associate
Richard T. McLaren, 2883 Harrison Ave., Cincinnati, Ohio (Barrows Co.) Active
Jack Shafer, 5576 Montgomery Rd., Cicninnati, Ohio (Max Wacher Co.) Associate

Cleveland Branch

Sylvester G. Domen, 1534 Van Lee Circle, Mobile, Alabama, Active
Robert W. Renton, 1780 Idlehurst Dr., Euclid, Ohio, Associate

Detroit Branch

Wilbur C. Thiess, 16543 Five Point Rd., Redford Twp., Detroit, Mich., Associate
Ralph A. McDonald, 1003 Hutchins Ave., Ann Arbor, Mich., Active
Adam J. Seibert, Jr., 4228 Arlington Dr., Royal Oak, Mich.
George A. Pillsbury, 1104 Nottingham Rd., Grosse Pointe Park, Mich., Associate
Clarence G. Chambers, Wayne Div. Bendix Aviation Corp., Wayne, Mich., Active

New York Branch

Frank Dagnessa, Dodge Inc., 126 South Street, Newark, N. J., Active
Ralph Kaplan, U. S. Bronze Co., New York City, Active
Vincent Ragone, Sperry Gyroscope Co., Brooklyn, N. Y., Active
Harold O. Booth, Eastern Aircraft, Tarrytown, N. Y., Associate

Philadelphia Branch

George C. Brown, Active

Toronto Branch

M. Novak, 476 Richmond St., Toronto, Ont., Associate

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